UNDERSTANDING MOOD INSTABILITY IN PREGNANT AND POSTPARTUM WOMEN: CROSS-SECTIONAL AND LONGITUDINAL STUDIES

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By

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ABSTRACT

The perinatal period has been recognized as a time of increased vulnerability for women to experience mood related symptoms and disorders. Women's reproductive years, particularly, pregnancy and postpartum, are often associated with increased moodiness. These seemingly "harmless" mood fluctuations are often regarded as a normal part of a woman's life. Therefore, there is very limited research on perinatal mood instability (MI). The primary goal of this dissertation was to systematically review the current existing literature of perinatal MI, its relation to perinatal depression, and its effects on children. The second goal was to examine the risk factors for perinatal MI, the association between antenatal MI and postpartum depression (PPD), and the trajectory of perinatal MI. The third goal was to investigate effects of antenatal MI, depression, and anxiety on neonatal outcomes. The fourth goal was to evaluate the construct validity of the Affective Lability Scale-18 (ALS-18) in pregnant and postpartum women with mood symptoms.

Manuscript one systematically reviewed existing literature on perinatal MI, its relation to perinatal depression, and its effects on children. A significant gap in perinatal MI research was identified.

Manuscript two's results suggest that depression, history of depression, stress, and labour/birth complications were significant risk factors for perinatal MI in a community sample of 648 women. Mood instability during early pregnancy was strongly associated with PPD. In addition, the trajectory of perinatal MI had an overall decreased trend through perinatal period.

Manuscript three's findings indicate no association between antenatal MI or antenatal depression and neonatal outcomes in a community sample of 648 women. Antenatal anxiety was significantly associated with low 1-minute and 5-minute Apgar scores and LBW.

Manuscript four explored the psychometric properties of the ALS-18 in a clinical sample of 113 perinatal women with various mood symptoms. The findings suggest that ALS-18 is an effective instrument for assessing MI in perinatal women

Taken together, the findings implicate that more research on perinatal MI is needed. In order to optimize the wellbeing of mothers, their babies, and their families, increasing awareness of perinatal MI among the general public and health care professionals, and screening and assessing women for perinatal MI are essential.

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DEDICATION

This dissertation is dedicated to:

My beloved parents, Shuzhao Li and XiuQing Yang for their unconditional love.

My husband, Junyuan Ma, and my son, Aoxiang Adam Ma for their love, support, and belief in me.

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LIST OF ABBREVIATIONS

ACES	Adverse childhood experiences
ADHD	Attention deficit hyperactivity disorder
AGA	Appropriate for gestational age
AIC	Akaike's Information Criterion
AIM	Affect Intensity Measures
ALS	Affective Lability Scales
ALS-18	Affect Lability Scale-18
ALS-54	Affective Lability Scale-54
ALS-SF	ALS short form
AR	Autoregressive
BD	Bipolar disorders
BDI	Beck Depression Inventory
BIC	Bayesian's Information Criterion
BPD	Borderline personality disorder
BW	Birth weight
CASP	Critical Appraisal Skills Program
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CI	Confidence intervals
CIS	Clinical Interview Schedule
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition
DSM-V	Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition
DV	Dependent variable
EFA	Exploratory Factor Analysis
EMA	Ecological Momentary Assessment
EPDS	Edinburgh Postnatal Depression Scale
FIP	Feelings in Pregnancy and Motherhood Study
GAD-7	Generalized Anxiety Disorder Scale

HMR	Hierarchical multiple regression
HPA	Hypothalamic-pituitary-adrenal
I/ELS	Impulsivity/Emotional Lability Scale
IIC	Item internal consistency
IDV	Item discriminant validity
IV	Independent variable
LBW	Low birth weight
LGA	Large for gestational age
LMM	Linear mixed model
MDQ	Mood Disorder Questionnaire
MI	Mood instability
MLS	Mood Lability Scale
MMHP	Maternal Mental Health Program
MSSD	Mean square successive difference
OCD	Obsessive compulsive disorder
OR	Odds ratio
PANAS	Positive and Negative Affect Scale
PHAC	Public Health Agency of Canada
PDSS	Postpartum Depression Screening Scale
PPB	Postpartum blues
PPD	Postpartum depression
PRISMA	Preferred Reporting Items for Systematic Review and Meta-Analysis
PTB	Preterm birth
PTSD	Post-traumatic stress disorder
RA	Research assistant
RMSEA	Root mean square error of approximation
SEM	Structural equation modeling
SES	Socioeconomic status
SGA	Small for gestational age
SHR	Saskatoon Health Region

T1	Time 1; early pregnancy
T2	Time 2; late pregnancy
T3	Time 3; postpartum
TLI	Tucker Lewis Index
VAS	Visual Analogue Scale
VIF	Variance inflation factors
11β-HSD2	11β-hydroxysteroid dehydrogenase type 2

Chapter 1: Introduction

Having a baby is a life-changing event for a woman. For most new mothers, the birth of a child arouses joy and a sense of fulfillment (Petch & Halford, 2008). An ideal image of happiness and excitement is widely associated with childbirth in our society (Petch & Halford, 2008). However, the perinatal period, which spans from conception to the first 12-months postpartum, is a period of major transition that can bring about many challenges for the woman and her family (Matthey, 2010; Nelson, 2003). For example, changes in relationships, new roles and responsibilities, different daily routines and work patterns, and perhaps financial difficulties can occur (Nelson, 2003). During this period, expectant and new mothers also undergo many psychological and biological changes throughout pregnancy, birth, and breastfeeding. Thus, although pregnancy, giving birth, and postpartum are the most natural reproductive phenomena, they are associated with significant stress, for example, nausea and vomiting during pregnancy that can have an negative impact on the quality of a woman's life (Chou, Avant, Kuo, & Fetzer, 2008), remarkable emotional, behavioural, cognitive adjustments to adapt to the demands of motherhood during postpartum and infant care, and the lack of sleep and resulting fatigue that commonly occur in postpartum women (Goyal, Gay, & Lee, 2007).

In addition, this transition toward motherhood represents a time of greater vulnerability for women to develop mood related disorders, such as perinatal depression, anxiety, and other mood disturbances including mood instability (MI) (Bowen, A., Bowen, Balbuena, & Muhajarine, 2012; Kessler et al., 2003; Steiner, Dunn, & Born, 2003). Depression in women is second only to HIV/AIDS regarding global morbidity (O'Hara, 2009). Epidemiologic studies suggest that the lifetime prevalence of mood disorders in women is approximately twice that of men (Kessler et al., 2003; Weissman et al., 1996). Perinatal mood disorders have been investigated extensively; in particular, perinatal depression and anxiety have received substantial research attention (Guintivano, Manuck, Meltzer-Brody, 2018; Katon, Russo, & Gavin, 2014; Leigh & Milgrom,

2008; Pope & Pope, 2000).

1.1 Perinatal depression

Perinatal depression encompasses major and minor depressive episodes that occur during pregnancy or up to one year following delivery (Matijasevich et al., 2015). Prevalence estimates for antenatal depression range from 7.4% in the first trimester, to 12.8% in the second and 12.0% in the third (Bennett, Einarson, Taddio, Koren, & Einarson, 2004). The prevalence rate was estimated at 19.2%, for minor and major depression in the first 3-months of postpartum (Gavin et al., 2005). Based on the data of the Maternity Experiences Survey of the Canadian Perinatal Surveillance System, Dennis, C., Heaman, and Vigod (2012) examined 6,421 women between 5 and 14 months postpartum, and assessed depressive symptoms using the Edinburg Postnatal Depression Scale (EPDS), and found that about 8% of Canadian women experienced depression (EPDS $\geq$ 13) in the past 12 weeks during the postpartum period. Another Canadian study, a longitudinal cohort of 648 perinatal women utilizing EPDS ($\geq$ 12) to measure depressive symptoms, found that 14% of women exhibited depressive symptoms at 17 weeks pregnancy, 10.4% at 31 weeks pregnancy, and 8.1% at 4 weeks postpartum (Bowen, A., Bowen, Butt, Rahman, & Muhajarine, 2012). The authors suggested that antenatal depression seems to be more prevalent than postpartum depression (PPD), and perinatal depression appears to have a declined trend from pregnancy to postpartum. Similar findings were reported in a longitudinal study with 239 women using the Clinical Interview Schedule (CIS) to measure depressive symptoms: 15.5% of women were depressed during early and mid-pregnancy, 11.1% during in the third trimester, and 8.7% during 8-10 weeks postpartum (Felice, Saliba, Grech, & Cox, 2004).

Throughout pregnancy and early postpartum, hormones such as estrogens, and progesterone associated with pregnancy and parturition fluctuates substantially (Klier et al., 2007; O'hara, Schlechte, Lewis, & Varner, 1991; Soldin et al., 2005), which coincides with increasing prevalence

rates of a depressive episode (Bennett, Einarson, Taddio, Koren, & Einarson, 2004; Bowen, A., Bowen, Butt, Rahman, & Muhajarine, 2012; Matijasevich et al., 2015). The unique timing of depressive symptoms observed in perinatal women and the biology of the perinatal period have sparked investigations into whether the depressive symptoms experienced by perinatal women are unique or different from the depression occurring during non-perinatal periods. A majority of evidence has shown that the symptoms of antenatal depression and PPD seem to be remarkably similar to the symptoms of depression occurring at other times in the lifespan (Boath & Henshaw, 2001). The Diagnostic and Statistical Manual of Mental Disorders Fifth Edition (DSM-V) supports this point of view, and the description of major depression includes an antenatal or postpartum onset up to the first four weeks postpartum (American Psychiatric Association, 2013). Major depression symptoms in the DSM-V include nine symptoms: depressed mood, loss of interest or pleasure, change in weight or appetite, insomnia or hypersomnia, psychomotor agitation or retardation, loss of energy or fatigue, worthlessness or guilt, impaired concentration or indecisiveness, and recurrent thoughts of death or suicidal ideation or attempt (American Psychiatric Association, 2013).

To detect and treat perinatal depression early, screening is the key (O'Hara & McCabe, 2013). The World Health Organization (WHO) does not have a guideline for maternal depression screening. Nationally, the Canadian Task Force on Preventive Health Care recommended only screening for perinatal depression when symptoms are apparent (Joffres et al., 2013). Universal screening for perinatal depression has not been recommended at a national level in Canada. Provincially, the British Columbia government developed guidelines entitled “Best Practice Guidelines for Mental Health Disorders in the Perinatal Period” which recommended that universal screening of perinatal women should occur at periodic intervals (Williams et al., 2014). In Saskatchewan, the “MotherFirst” strategy recommended universal screening of perinatal women

for both depression and anxiety starting at first prenatal visits, at 28-34 weeks pregnancy, at three weeks postpartum, and again at the time when children have their immunizations (Bruce, Béland, & Bowen, A. 2012). Internationally, the UK's National Institute for Health and Care Excellence developed "Antenatal and postnatal mental health: clinical management and service guidance", with guidelines covering every stage of a woman's experience of childbearing from pre-conception to postpartum (National Collaborating Centre for Mental Health, 2014). In 2009, the Government of Australia developed the National Perinatal Depression Initiative, and updated the Initiative in 2017, which recommended that women should be universally screened for depression: the first time of screening antenatal depression as early as practical in pregnancy and repeat screening at least once later in pregnancy; for postpartum women, screening depression 6 – 12 weeks after birth and repeat screening at least once within 12 month of postpartum (Austin, Highet, & Expert Working Group, 2017). To improve maternal mental health, a national strategy for maternal mental health should be prioritized in Canada (Williams et al., 2014).

1.2 Perinatal anxiety

The perinatal period from pregnancy to up to one year postpartum is considered to be a time of significant risk for experiencing anxiety symptoms (Brockington, Macdonald, & Wainscott, 2006). The ratio of anxiety disorders between women and men is estimated at 2:1, which is similar to depression (Glover, 2014; Martini et al., 2015). According to the DSM-V, anxiety disorders include a spectrum of disorders, for example, generalized anxiety disorder, panic disorder, and phobias (American Psychiatric Association, 2013). In addition, perinatal-related anxiety is characterized by pregnancy-specific and birth-specific fears and worries, which may appear to be a unique type of anxiety response in women (Huizink, Mulder, de Medina, Visser, & Buitelaar, 2004).

The prevalence of perinatal anxiety between 2006 and 2014 was estimated to be 2.6 - 39% in pregnancy period and 3.7 - 20% during postpartum according to a systematic review on 98 articles worldwide (Leach, Poyser, & Fairweather-Schmidt, 2017). In a UK study of 8,323 women recruited between April 1991 and December 1992, 1,105 (13%) women experienced anxiety symptoms across the eight-week and eight-month postpartum assessments, and two-thirds of these women reported that they experienced anxiety in pregnancy (Heron et al., 2004). A computer-assisted telephone survey with 1,507 Australian women expecting their first child found that 8.5% of women experienced intense anxiety or panic attacks occasionally or often between 6-9 months postpartum (Woolhouse, Brown, Krastev, Perlen, & Gunn, 2009). Information on Canadian prevalence of perinatal anxiety is lacking. The Public Health Agency of Canada (PHAC) estimated the prevalence of perinatal anxiety to be about 16% in 2002 (PHAC, 2002).

Increasing evidence indicates that women experience anxiety frequently during pregnancy and postpartum, and the prevalence rate of anxiety is higher than the rate of depression during the perinatal period (Heron et al., 2004; Meades & Ayers, 2011). Despite the scientific evidence of anxiety in perinatal women, there are no current guidelines for screening perinatal anxiety globally or nationally in Canada. Provincially, the British Columbia government developed guidelines entitled “Best Practice Guidelines for Mental Health Disorders in the Perinatal Period” which recommended the same screening for anxiety as exists for depression (Williams et al., 2014). In Saskatchewan, the “MotherFirst” strategy recommended the same universal screening of perinatal women for anxiety (Bruce et al., 2012). Once again, a national strategy for diagnosing perinatal anxiety and depression should be in place.

1.3 The relationship between perinatal anxiety and depression

Although anxiety and depression are two separate disorders, they occur comorbidly in as many as 30 - 58% of patients with depression in non-perinatal population (Pollack, 2005; Young,

Abelson, & Cameron, 2004). Pollack (2005) suggests that patients that have depression with comorbid anxiety experience more severe depressive symptoms and more prolonged depressive episodes in comparison with patients with only depressive symptoms. For perinatal women, studies report a strong association between postpartum anxiety and PPD, with the two conditions often occurring concurrently (Stuart, Couser, Schilder, O'Hara, & Gorman, 1998; Wenzel, Haugen, Jackson, & Brendle, 2005). Women who report experiencing anxiety during pregnancy are also significantly more likely to experience postpartum anxiety (Austin, Tully, & Parker, 2007; Heron et al., 2004). A French study of 497 perinatal women, who were assessed at their third trimester and at six weeks postpartum, found that anxiety during late pregnancy is an independent predictor for intensity of PPD symptoms (Sutter-Dallay, Giaconne-Marcesche, Glatigny-Dallay, & Verdoux, 2004). A population-based study of 4,451 postpartum women in the US reported that of the 18% of women who experienced anxiety, 35% also reported postpartum depressive symptoms, indicating 6.3% of comorbidity (Farr, Dietz, O'Hara, Burley, & Ko, 2014).

In the literature of comorbidity among psychiatric disorders, studies suggest that comorbidity may reflect overlapping diagnostic criteria, and arbitrary subdivision of syndromes when one disorder displays an early symptom of another, or one disorder is part of another disorder (Brown, Campbell, Lehman, Grisham, & Mancill, 2001; Cerdá, Sagdeo, & Galea, 2008; Kessler, Chiu, Demler, & Walters, 2005). In regards to the association between anxiety and depression, the comorbidity between them has been conceptualized in a tripartite model (Clark & Watson, 1991). The model suggests that depression and anxiety have their distinct symptoms, for example, anhedonia for depression and hyperarousal for anxiety, but they share a central common ‘distress’ component. The shared general distress factor is manifested both as a transient state and as a more stable trait (Clark & Watson, 1991), and is in line with an internalizing factor in depression, generalized anxiety, and social anxiety (Lahey et al., 2004; Slade & Watson, 2006; Vollebergh et

al., 2001). Emotion regulation appears to play an important role in anxiety and depressive disorders, for example, emotion dysregulation may create cognitive and functional difficulties in individuals with anxiety and/or depression, such as decreased awareness, poor understanding, inhibited or inappropriate expression, and difficulty managing emotions (McLaughlin, Hatzenbuehler, Mennin, & Nolen-Hoeksema, 2011; Southam-Gerow & Kendall, 2000).

1.4 The trajectory of perinatal depression and anxiety

A majority of cases of PPD were reported experiencing depressive symptoms during pregnancy, suggesting strong predictability of antenatal depression for PPD (Heron et al., 2004). In the same study with 8,469 women in the UK, Heron et al. (2004) found that 43.7% of women with PPD were preceded by elevated depressive symptoms at early, mid, or late pregnancy. In regards to onset timing of antenatal depression, a UK study with 9,028 women found that of the 7,966 women who were not depressed at 18 weeks of pregnancy, 673 (8.4%) were new cases of depression at 32 weeks of pregnancy. Of the 7,806 non-depressed women at 32 weeks of pregnancy, 419 (5.3%) became depressed at eight weeks postpartum (Evans, J., Heron, Francomb, Oke, & Golding, 2001). In a systematic review, Pope (2000) suggested that 40-50% of all new cases of PPD reported an onset within the first three months after giving birth. Smith and Howard (2008) reported that maternal depressive symptoms had a declining trend from 6 to 24 months postpartum. Similarly, Heron et al. (2004) found a mean decrease in depressive symptoms from pregnancy to postpartum. In regards to duration, remission among women with PPD was reported about 25-60% within the first three-six months postpartum, and within the first 12 months an additional remission of 15-25% was found (Pope & Pope, 2000). However, McMahon et al. (2011) suggested that 56% of the women who were diagnosed with depression at four months postpartum reported experiencing depressive symptoms between one to four years postpartum.

Research examining the course of anxiety has been less consistent. Studies found relative stability in anxiety from pregnancy to postpartum as a majority (64%) of women who experienced an elevated level of anxiety during early pregnancy also reported an increased level of anxiety during postpartum (Heron et al., 2004). Grant, McMahon, and Austin (2008) also found that 47.6% of women who met criteria for an anxiety disorder during pregnancy continued to meet the criteria in postpartum, suggesting that antenatal anxiety is the best predictor for postpartum anxiety. Similar to depression, Heron et al. (2004) found a mean declining for anxiety level from pregnancy to postpartum overall. In contrast, other research showed that the course of anxiety during perinatal period had a fluctuating trend. For example, Teixeira et al. (2009) found that anxiety symptoms follow a U-shaped pattern during pregnancy: elevated during the first trimester, declined during the second trimester, and elevated again in the third trimester.

1.5 Risk factors for perinatal depression and anxiety

The etiology of perinatal depression and anxiety remains unclear; however, it is known that there is no one single cause (O'Hara & McCabe, 2013). Although neurobiological and genetic studies of depression and anxiety demonstrated that some individuals have a genetic vulnerability or predisposition to developing mood disorders, other psychosocial and non-psychosocial factors also play a role in causing the disorders (Dubovsky, Davies, & Dubovsky, 2003).

Studies on the risk factors for antenatal depression concluded that significant predictors for antenatal depression and anxiety include multiparity, unintended pregnancy, low self-esteem, antenatal anxiety, low social support, negative cognitive style, major life events, low income, and history of abuse (Fellenzer & Cibula, 2014; Halbreich, 2004; Lee et al., 2007; Leigh & Milgrom, 2008). Antenatal depression is also identified as a mediator between PPD and other risk factors (low self-esteem, antenatal anxiety, low social support, negative cognitive style, major life events, low income and history of abuse) (Katon, Russo, & Gavin, 2014; Leigh & Milgrom, 2008).

Ample studies have been conducted to investigate risk factors for PPD, including cross-sectional and longitudinal studies. The best-estimated risk factors are proposed to be a history of depression, antenatal depression, antenatal anxiety, and adverse life event (Guintivano, Manuck, Meltzer-Brody, 2018; Pope, S. & Pope, 2000; Robertson, Grace, Wallington, & Stewart, 2004). Stowe, Hostetter, and Newport (2005) suggest that nearly 90% of women with antenatal depression had a history of depression, while over 50% of women reported a history of PPD. A longitudinal study investigates the relationship between perinatal depression and a history of mental health problems before conception in adolescence and young adults, and found that a history of mental health problems predicts perinatal depression (Patton et al., 2015). The study indicates that 34% of women with a history of mental health problems experienced symptoms of perinatal depression, compared to 8% of those without a history of mental health problems.

A synthesis of two major meta-analyses conducted on over 14,000 women, and subsequent large-scale clinical studies identified strong, moderate, and weak risk factors for PDD (Roberts, A. et al., 2004). Strong risk factors for PPD include antenatal depression, a history of depression, and a history of mental health disorders, life events, and lack of social support; moderate risk factors are recognized as neuroticism and marital relationship; weak risk factors are known as obstetric factors and socioeconomic status; maternal age, level of education, and parity were not associated with PPD (Robertson et al., 2004). Other studies produce mixed results of risk factors for PPD: maternal age and parity, terminating breastfeeding, and childhood abuse (Reck et al., 2008; Wilkinson & Scherl, 2006; Ystrom, 2012). The mixed results may be due to different measures, or assessment at various time points of perinatal period.

Risk factors for anxiety during the postpartum period have been identified, for example, low self-esteem, poor social support, cesarean birth, stress, and child sleep problems (Clout & Brown, 2015; Koh et al., 2015). A Canadian study of 522 women found that the following risk

factors increase the likelihood of postpartum anxiety: multiparous parity, history of psychiatric problems, perceived stress, and childcare stress (Dennis, C, Falah-Hassani, Brown, & Vigod, 2016). Relatively limited research is available on risk factors for perinatal anxiety, especially the longitudinal relationship between perinatal anxiety and its risk factors at different timing of perinatal period.

1.6 Effects of perinatal depression and anxiety on mothers, neonatal, and child health outcomes

Perinatal depression and anxiety have a profound impact on women's lives; ranging from physical, psychological, and mental suffering to diminishing their ability to function effectively (O'Hara & McCabe, 2013). Thus, the consequences of perinatal depression and anxiety can be far-reaching and extended to the long-term effects on women, their children, and their family.

1.6.1 Effects of perinatal depression and anxiety on mothers

During the perinatal period, mothers with depression and anxiety are more likely to experience somatic symptoms, anxiety, irritability, withdrawal, sadness, worthlessness, or guilt (O'Hara, 2009). Mothers with antenatal depression have been found to be less interested in attending perinatal classes and routine check-ups, and are less likely to adhere to a nutritious diet (Lee et al., 2007; Leigh & Milgrom, 2008). Studies showed that mothers with perinatal depression are significantly associated with the risk for suicidality (Lindahl, Pearson, & Colpe, 2005; Sit et al., 2015). Depressed and anxious mothers are at a higher risk of using tobacco, alcohol, and drugs (Bonari, Bennett, Einarson, & Koren, 2004; Chan, Natekar, Einarson, & Koren, 2014). Studies showed that women with depression and anxiety are more likely to experience labour/birth complications such as caesarean section, induced labour, or pre-term birth (Andersson, Sundström-Poromaa, Wulff, Åström, & Bixo, 2004; Wilkie & Deligiannidis, 2014). In regards to infant care, mothers with PPD are less likely to breastfeed their babies or are more likely to discontinue

breastfeeding (Dennis, C. & McQueen, 2009; Hahn-Holbrook, Haselton, Schetter, & Glynn, 2013). Less optimal infant sleep practices have been observed in mothers who experience depressive symptoms, such as sharing a bed with parents, prone position, and disturbed sleep patterns (Dennis, C. & Ross, 2005; Sadeh, Tikotzky, & Scher, 2010).

Parenting styles among mothers with PPD have been documented. Mother-infant interaction has been viewed as a very important aspect of late cognitive, social, emotional and physical development (Field, T., Diego, & Hernandez-Reif, 2006). Depressed mothers have been observed using less vocal and visual communication, being withdrawn and passive, and displaying less affection and smiling during interactions with their infants (Ferber, Feldman, & Makhoul, 2008; Field, 2010). Mothers with PPD were found less likely to read, sing, and play games with their babies (Paulson, Dauber, & Leiferman, 2006). Depressed mothers were found to be more likely to use physical punishment in parenting, such as slapping or spanking the child with an object (McLearn, Minkovitz, Strobino, Marks, & Hou, 2006).

Perinatal depression and anxiety may put a strain on women's relationships with their partners. Postpartum depression has been associated with marital dysfunction such as disagreements, hostility, withdrawal, separation, and divorce (Davies & Windle, 1997; Meadows, McLanahan, & Brooks-Gunn, 2007). Furthermore, marital problems persist beyond women's remission from the depression (Goodman, 2005). Studies found that men whose partners experience PPD are at an increased risk of developing a depressive disorder, having non-specific psychological issues, experiencing fatigue, and more likely to seek a marital separation or divorce (McCue-Horwitz, Briggs-Gowan, Storfer-Isser, & Carter, 2007; Roberts, S., Bushnell, Collings, & Purdie, 2006).

1.6.2. Effects of perinatal depression and anxiety on neonatal and child outcomes

The work of Barker's fetal origins of adult disease hypothesis states that adverse influences early in development, and particularly during intrauterine life, can result in permanent changes in physiology and metabolism, which result in increased disease risk in adulthood (Godfrey & Barker, 2001). The key observation was based on birth weight (BW) that was a strong risk factor for coronary heart disease, diabetes mellitus, and obesity later in life (Barker, 2002; Das, 2003).

Perinatal depression and/or anxiety have been associated with adverse neonatal outcomes such as low BW, small for gestational age (SGA), preterm birth, and low Apgar score (Berle et al., 2005; Glover, O'Connor, & O'Donnell, 2010; Li, Liu, & Odouli, 2008; Patel, V. & Prince, 2006). Several potential causal pathways through which prenatal depression and anxiety may lead to adverse birth outcomes have been proposed. One potential mechanism was identified as changes in maternal hypothalamic–pituitary–adrenal (HPA) axis activity. Increased maternal HPA axis activity has been observed during the perinatal period (Smith, A. et al., 2011). However, experiencing elevated levels of depression and anxiety during pregnancy may contribute to an increase in stress hormones, such as cortisol and catecholamine (Evans, L., Myers, & Monk, 2008). The release of stress hormones have also been found to cause changes in immunologic functioning and uterine blood flow during human pregnancy, thus increasing vulnerability to preterm birth, SGA, and low BW (Challis, 2000; Chen, K., Chen, L., & Lee, 2012; Goldenberg, Culhane, Iams, & Romero, 2008; Harrington, Cooper, Lees, Hecher, & Campbell, 1996; Misra, Hobel, & Sing, 2009; Mulder et al., 2002). In addition, placental 11β-hydroxysteroid dehydrogenase type 2 (11β-HSD2) as another potential mechanism contributing to adverse birth outcomes has been investigated. 11β-HSD2, which catalyzed rapid inactivation of maternal corticosterone to inert 11-dehydrocorticosterone, served as a physiological 'barrier' to maternal glucocorticoids. Maternal depression and anxiety negatively correlated with placental 11β-HSD2 mRNA expression and

activity depressed placental barrier function (O'Donnell et al., 2012). Evidence indicated that overexposure to maternal glucocorticoids induced by downregulation of 11β-HSD2 mRNA expression and activity predicted subsequent preterm birth (PTB) and low BW (Dy, Guan, Sampath-Kumar, Richardson, & Yang, 2008; Kajantie et al., 2003).

Extensive research has suggested that maternal depression and anxiety can have a negative impact on the infant and the mother-infant relationship, and also has a long-lasting effect on childhood and beyond (O'Hara & McCabe, 2013). For example, Field (1984) investigated the early interaction between infants and depressed mothers at three months postpartum, and found the depressed mothers' infants show fewer positive facial expressions and more negative expressions compared to infants with non-depressed mothers. Infants of mothers with PPD were observed having regulation difficulties as early as one month after delivery, for instance, infants displayed poorer self-regulation, more stress signs, and heightened arousal compared with infants of mothers without PPD (Salisbury et al., 2007). Studies on mother-infant interactions found that women with PPD are linked to maternal withdrawal, disengagement, intrusion, and hostility (Lovejoy, Graczyk, O'Hare, & Neuman, 2000; Martins & Gaffan, 2000). An association between PPD and insecure infant attachment with predominantly avoidance was suggested at 12 months and 18 months (McCabe, 2014; Stacks et al., 2014). Regarding the longer term outcome, maternal depression has been associated with behavioural, cognitive, and health-related problems in children's development (O'Hara & McCabe, 2013). Brennan et al. (2000) examined the relationship between PPD and child behaviour, and found that both severity and chronicity of maternal depressive symptoms predicted future child behavioural problems, which was confirmed in another prospective longitudinal study of children with depressed mothers (Bell, Bayliss, Glauert, Harrison, & Ohan, 2018). The literature investigating the impact of PPD on child cognitive development has been well documented. Several studies have shown that PPD predicts poorer language and IQ development in

children, and that the effect may last into adolescence (Brand & Brennan, 2009; Grace, Evindar, & Stewart, 2003; Sohr-Preston & Scaramella, 2006). Finally, negative impacts on physical development have been related to PPD, such as poor child physical growth (Ertel, Koenen, Rich-Edwards, & Gillman, 2010).

1.7 Mood Regulation

Mood can vary from moment to moment, and one's transient moods can have profound impacts on judgment, behaviour, and a variety of cognitive process (Clore et al., 2001). Mood regulation is conceptualized as consisting of a series of modifying or maintaining of the occurrence, duration, and intensity of both negative and positive moods (Cole, Martin, & Dennis, 2004; Eisenberg & Spinrad, 2004; Larsen, 2000). One assumption is that people want to feel good, therefore are motivated do things by creating and retaining the pleasure they feel (Larsen, 2000). Larsen (2000) analogues mood regulation as a home thermostat in the winter or air-conditioner in the summer. The "feeling good" mood is the temperature people set on the thermostat/air-conditioner. When the temperature in the home is altered by opening the door or outside temperature, the thermostat/air-conditioner starts to work or regulate until the indoor temperature returns to the "feeling good" point. Individuals either consciously or automatically use various strategies to regulate their mood (Larsen, 2000). Some of the strategies focus on modifying emotions, for example by distracting the attention away from the negative situations, reappraising the situation, and labeling the emotions (Schmidt, Tinti, Levine, & Testa, 2010). Individual differences of mood regulation or ability to regulate mood have many important consequences, for example, mood dysregulation or mood instability (MI) have been associated with many psychopathologies (depression, borderline personality disorder (BPD), anxiety disorder) (Bowen, R., Baetz, Hawkes, & Bowen, 2006; Thompson, R. J., Berenbaum, & Bredemeier, 2011; Trull et al., 2008).

1.8 Mood Instability

Mood instability is widely described in psychiatric literature. The term is used interchangeably with mood dysregulation, affective instability, affective lability, affective and emotional dysregulation, and mood swings (Marwaha, Broome, Bebbington, Kuipers, & Freeman, 2014; Teicher, Ohashi, Lowen, Polcari, & Fitzmaurice, 2015). Mood instability is defined as "extreme and frequent fluctuations of mood over time" (Trull et al., 2008). Mood instability as a trait is defined as "a marked reactivity of mood" in the DSM-V as a borderline personality disorder (BPD) criterion (American Psychiatric Association, 2013). Mood instability is a psychophysiological symptom reported not only in psychopathologies, such as BPD and bipolar disorders (BD), but it is also seen in other psychiatric disorders (e.g., depressive, anxiety, eating disorders, substance abuse, seizures, and brain lesions) (Anestis et al., 2009; Benazzi, 2008; Bowen, R., Balbuena, Peters, Leuschen-Mewis, & Baetz, 2015; Bowen, R., Clark, & Baetz, 2004; Kober & Bolling, 2014; Koenigsberg, 2010; Sobanski et al., 2010; Thompson, R. J. et al., 2011). Patients often describe MI as an "emotional roller coaster" that related to a subjective sense of strong affects and emotions that are experienced in an uncomfortable and rapid sequence. Based on a study of the Adult Psychiatric Morbidity Survey 2007 in England, the prevalence of MI was estimated as 13.9% of the population over 16 years of age (Marwaha, Parsons, Flanagan, & Broome, 2013).

1.8.1 The association between mood instability and psychiatric disorders

According to DSM-V, MI is not a diagnosable psychiatric disorder, however, evidence has gradually emerged that MI as a stable personality trait increases vulnerability to a variety of mental disorders (Berenbaum, Bredemeier, Boden, Thompson, & Milanak, 2011). Mood instability constitutes a primary feature of various types of psychopathology including depression (Bowen, R., Wang, Balbuena, Houmphan, & Baetz, 2013; Thompson, R. J. et al., 2011), anxiety (Bowen, R. et

al., 2004; Campbell-Sills, Barlow, Brown, & Hofmann, 2006), BD (Hofmann & Meyer, 2006; Stange et al., 2016), eating disorders (Anestis et al., 2009; Santangelo et al., 2014), suicidality (Arria et al., 2009; Baetz & Bowen, 2011), attention deficit hyperactivity disorder (ADHD) (Gudjonsson, Sigurdsson, Adalsteinsson, & Young, 2013; Skirrow & Asherson, 2013), post-traumatic stress disorder (PTSD) (Kashdan, Uswatte, Steger, & Julian, 2006; Marwaha, Parsons, & Broome, 2013), and BPD (Conklin, Bradley, & Westen, 2006; Leichsenring, Leibing, Kruse, New, & Leweke, 2011). Some researchers suggested that MI is important and distinct enough to be considered as a separate construct (Angst, Gamma, & Endrass, 2003; Bowen, R., Baetz, Leuschen, & Kalynchuk, 2011; Marwaha, Parsons, & Broome, 2013).

1.8.2 Neurobiological risk factors for mood instability

Most of neurobiological studies in the relationship between MI and neurobiological factors have been focused on borderline personality disorder (BPD) and bipolar disorder (BD). Mainly because MI is a core feature of BPD and BD, and has assumed importance in the psychiatric literature (Aas et al., 2015; American Psychiatric Association, 2013). Neuroimaging has been commonly used to investigate structure-function and brain-behaviour relationships.

Ample hypotheses have suggested the relationships between MI and neural substrates, between MI and neural networks, and between MI and neurochemical modulatory mechanisms (Kober & Bolling, 2014). For example, the wealth of the studies suggested that anomalies in amygdala activity and connectivity underlie the emotional instability in BPD (Broome, He, Iftikhar, Eyden, & Marwaha, 2015; Koenigsberg et al., 2014; Schulze, Schmahl, & Niedtfeld, 2016). Whalley et al. (2015) report that there are deficits within fronto-limbic connections in individuals with BPD. Three networks (salience network, default mode network, and central executive network) have been known for their involvement in emotion and behaviour regulation in patients with BPD (Doll et al., 2013). Given the dominant role of the central executive network in

cognitive control and the salience network in emotion regulation, studies examined intrinsic functional connectivity within the three networks, and provide evidence for an aberrant three network in BPD (Doll et al., 2013; Wolf et al., 2011). Jukic et al. (2015) suggested that aberrant development of monoaminergic neurons leads to mood fluctuations, and may be associated with BD. Studies suggest that a reduced connectivity between dorsolateral prefrontal cortex and amygdala may reflect abnormal modulation of mood in bipolar patients (Radaelli et al., 2015), and impairment of the ventromedial system is responsible for involuntary regulation of the behavioral response to emotional stimuli, and the appraisal and encoding of emotional stimuli in patients with BD (Almeida et al., 2009).

Dysregulations of homeostatic mechanisms may play an important role of affective instability in depression and PTSD, specifically, dysregulations of the feedback loops (Siever & Davis, 1985; Yehuda, Teicher, Trestman, Levengood, & Siever, 1996). Under-responsive feedback signals of homeostatic mechanisms may be associated with affective instability in patients with depression (Siever & Davis, 1985), and over-responsivity of the feedback signals are proposed to be the link between affective instability and PTSD (Yehuda et al., 1996). Dysregulation of amygdala neural circuitry has been documented to be central to development and maintenance of symptoms with PTSD (Aghajani et al., 2016; Etkin & Wager, 2007; Lanius et al., 2010). The structural/functional findings on brain scans of people with OCD indicated that white matter pathway abnormalities allow for unstable connectivity which might be related to MI (Bora et al., 2011), as well as abnormalities in the amygdala and its connections with the pre-frontal cortex (Broome et al., 2015).

A large body of studies suggest that prenatal adversity (e.g., prenatal stress, drugs, tobacco smoking or medical complications) may lead to intrauterine growth restriction and to impaired fetal development (Cottrell & Seckl, 2009; Seckl & Holmes, 2007). Prenatal adversity has been

associated with BPD, and is an important risk factor for the psychopathology of BPD (Schwarze et al., 2013; Swanson & Wadhwa, 2008). Affective instability was associated with elevated rates of family history of mood disorders (Berenbaum et al., 2011). Studies reported that offspring of parents with BD have higher levels of mood lability, negative affect, anxiety, and aggressive behaviours when compared with healthy controls (Chang, K., Steiner, & Ketter, 2000; Diler et al., 2011; Jones, Tai, Evershed, Knowles, & Bentall, 2006). There is substantial evidence of familial aggregation of BPD (White, Gunderson, Zanarini, & Hudson, 2003), and an even stronger familial aggregation of core features of BPD, specifically affective instability and impulsivity, compared to the fully diagnosed disorder (Barnow, Spitzer, Grabe, Kessler, & Freyberger, 2006; Davidson & Siever, 1991; Zanarini, Gunderson, Marino, Schwartz, & Frankenburg, 1988). These features have been found to aggregate separately, suggesting that they may be inherited independently (Davidson & Siever, 1991).

1.8.3 Psychosocial risk factors for mood instability

Affective instability has been linked to the impairment of interpersonal relationships (Koenigsberg, 2010). Studies both in a clinical sample and in a large adult population found that individuals with MI are more likely to be young, female, unemployed, single status, and have a low income (Marwaha et al., 2013; Patel, R. et al., 2015). Extensive studies on the relationship between MI and psychosocial factors have emphasized on the period of child development. Both theory and empirical studies suggest that relationship or attachment between infant and primary caregiver plays an essential role in infant's emotional regulatory abilities (Cassidy, 1994). The ability to regulate emotions in socially appropriate ways is an important objective for a child's development (Bridges & Grolnick, 1995; Calkins, 1994; Calkins & Leerkes, 2004; Tronick, 1989). During a child's development, emotional and adaptive regulatory strategies are learned through the interactions with primary caregiver (Chang, L., Schwartz, Dodge, & McBride-Chang, 2003;

Spinrad & Stifter, 2002), and learned using social interaction to regulate emotions (Koenigsberg, 2010). The ability to modify one's emotional reactions by utilizing emotional and adaptive regulatory strategies has a significant impact on the development of psychological and psychosocial capacities (e.g., coping with stressful events, controlling impulsive behaviour, flexibly using appropriate emotion regulation strategies to meet situation requirements) (Thompson, R. A., 2001). Attachment difficulties increase vulnerability to dysregulating emotions that may subject one to intense, unpredictable, or over-reactive shifts in affect that will result in impaired social interactions, low self-esteem, poor sense of identity, and lack of motivation (Koenigsberg, 2010).

Exposure to adverse childhood experiences (ACES) (e.g., abuse (emotional, physical, and sexual), neglect, maltreatment) has been associated with physical diseases, social malfunction, and mental illness through the life span (Dube et al., 2003; Read, Fosse, Moskowitz, & Perry, 2014; Van Niel, Pachter, Wade Jr, Felitti, & Stein, 2014). In addition, ACES can influence subsequent capacity for affect regulation. When the infant is maltreated or abused, the interaction between the infant and the caregiver most often fails to facilitate effective emotion regulation, and the caregiver most likely dismisses or punishes their child's emotional responses instead of validating them (Morris, Silk, Steinberg, Myers, & Robinson, 2007). The lack of sensitive interactions between the maltreating caregiver and the child can lead to emotion regulation difficulties (Kim & Cicchetti, 2010). Several studies confirm medium to high correlations between child maltreatment and emotion dysregulation in adulthood (Moulton, Newman, Power, Swanson, & Day, 2015; Rellini, Vujanovic, Gilbert, & Zvolensky, 2012; Zanarini, Williams, Lewis, & Reich, 1997). Teicher et al. (2015) investigated the association between child maltreatment and disturbances in positive or negative mood regulation, and suggests that positive mood ratings were more variable and negative ratings are more persistent.

Maternal psychopathology may menace the development of mood regulation abilities. Cione (2015) investigated the relationship between maternal depression, parenting practices and children's emotional and behavioural expression, and found that emotion dysregulation in children was significantly associated with behavioural problems. Cione (2015) also found that emotional regulation capacities in children play a mediating role between parental psychological aggression and the occurrence of child internalizing and externalizing behavioural problems. Maternal PTSD symptoms were associated with infant emotion regulation difficulties and with infant being less able to recover from distress (Enlow et al., 2011).

Exposure to adverse experiences and maternal mental illness during early child development can predispose children to poor emotion regulation that may lead to developing psychiatric disorders. Studies based on the US national comorbidity survey in 2001 and 2003 suggested that family violence, physical and sexual abuse, neglect, parental mental illness, substance misuse, and criminality may explain 32.4% of all disorders, 41.2% of disruptive behavior disorders, 32.4% of anxiety disorder, 26.2% of mood disorders, and 21.0% of substance use disorders in youth (Green et al., 2010; McLaughlin et al., 2010).

Neurobiological and psychological factors both contribute to affective regulation. Failure of regulating emotions has been proven to have significant consequences, from unstable interpersonal relationships to strong correlations with an array of psychiatric disorders.

1.8.4 Effects of mood instability

There is limited information on the impacts of MI in general and clinical population. One study found that inability or decreased ability to regulate mood has been linked to greater functional impairments (including interpersonal impairment), and decreased quality of life in the general population (Miller & Pilkonis, 2006). Myin-Germeys et al. (2009) investigated the correlation between interpersonal impairment and stressful events, and found that poor

interpersonal communication skills may contribute to stressful events (e.g., relationship break-up, getting fired from a job), which lead to decreased quality of life. In a clinical sample of 27,704 British adults with psychotic, affective or personality disorder (data was collected from 2006 to 2013), MI has been linked to poorer clinical outcomes, and correlated with increased health care utilization (Patel, R. et al., 2015). As described above, MI as a primary feature plays an essential role in many psychiatric disorders. Thus MI has a substantial negative impact on individuals who suffer from mental health disorders.

1.8.5 Measures

Different measures have been developed and used to assess constructs of MI in non-perinatal women population. A systematic review screened over 10,000 abstracts, analyzed 37 studies, and identified 24 distinct measures of MI (Marwaha et al., 2014). The measurements include self-reported scales such as the Affective Lability Scale (ALS) (Harvey, Greenberg, & Serper, 1989) and ALS short form (ALS-SF) (Oliver & Simons, 2004). While some of the measurements are according to DSM definitions, others are comprised of a few questions or items related to MI (Marwaha et al., 2014). However, perinatal-specific measures of MI have not yet been developed, and items unique to pregnancy and giving birth may need to be included in the development of MI measures for perinatal women.

The Affective Lability Scales 54 (ALS-54) has been widely used in measuring individual mood variation involving rapid shifts from different emotional states of anxiety, depression, anger and elation, and also between anxiety and depression, and elation and depression (Harvey et al., 1989). The ALS includes 54 items, structured into six subscales, evaluating lability shifts between normal mood and depression, elation, anxiety and anger, and variations between anxiety/depression and depression/elation (Harvey et al., 1989). The scales have high internal consistency (Cronbach's alpha = 0.72 -0.89) and do not vary by gender (Harvey et al., 1989).

Recognizing the lengthiness of the original ALS-54, Oliver and Simons (2004) developed a short form of ALS (ALS-18), which was derived from the ALS-54 and includes fewer questions (18 items), and consequently is less time-consuming. ALS-18 measures three correlated conceptual scales based on the original scales: depression/anxiety, anger, and biphasic affect (depression/elation). Each item is scored on a 4-point scale (0-3), ranging from "very uncharacteristic of me" to "very characteristic of me." The internal consistencies of the ALS-18 were determined to be favorable (Cronbach's alpha = 0.90), and the scale was highly correlated with the ALS-54 version (r = 0.94) (Look, Flory, Harvey, & Siever, 2010). The measurement has been validated in clinical samples, for example, personality disorders (Look et al., 2010), bipolar disorder (Aas et al., 2015), and ADHD (Weibel et al., 2017).

1.9 Perinatal mood instability

Mood instability has always been associated with women during their reproductive years in puberty, pre-menstruum, pregnancy, postpartum, and menopause.

Studies have found that perinatal women often experience the highest irritable, euphoric, and depressed moods in early pregnancy and again around the time of giving birth (Cunningham et al., 2010; Steiner et al., 2003). This phenomenon is thought to be triggered by the large hormonal changes that occur at these times (Buttner, O'Hara, & Watson, 2012; Cunningham et al., 2010; Fooladi, 2006). Bowen, A. et al. (2012) investigated MI in perinatal women in a longitudinal study, and found that perinatal women significantly experienced a higher level of depressed, irritable, anxious, and euphoric mood fluctuation compared to non-perinatal women with normal menstrual cycles.

This seemly 'harmless' phenomenon has been seen as a normal part of women's life. Therefore, little attention has been paid to it. However, MI is correlated with many psychiatric disorders as described earlier (Marwaha et al., 2013; Patel, R. et al., 2015). There is a growing

interest in research on MI in the general population and clinical samples, however, little study has been focused on MI in women during pregnancy and postpartum.

1.10 Effects of perinatal mood instability on mothers, and neonatal and child outcomes

Hapgood, Elkind, and Wright (1988) investigated the longitudinal relationship between postpartum blues (PPB) and later psychopathology during the perinatal period in 66 postpartum women. The study found that emotional lability during the early postpartum was the most important predictor of later psychiatric symptoms up to 14 months postpartum.

Jaffe et al. (2001) investigated the longitudinal relationship between facial affect synchrony in infant-mother interaction and infant development with a sample of 88 4-month-old infants and mothers. The study found that facial affect synchrony in infant-mother interaction at age 4 months predicts attachment and cognition at age 12 months, and suggested that facial affect synchrony in infant-mother interaction at a moderate level prompts a natural and appropriate interaction between mother and infant, whereas a heightened and lowered level of facial affect synchrony create impediment in infant development. Studies found that maternal psychiatric disorders obstruct the interaction between mother and infant (Field, T., 2010; Martinez-Torteya et al., 2014). For example, mothers with higher maternal depressive symptoms showed a heightened level of facial affect synchrony when interacting with their infants in comparison to mothers with lower depressive symptoms (Beebe et al., 2008).

Very limited studies in the area of perinatal MI have been found, especially the effects of perinatal MI. More research is required to understand perinatal MI.

1.11 Study rationale

Mood instability is common in women during pregnancy and postpartum, and has been associated with a wide array of psychiatric disorders. However, perinatal MI has not received much-needed attention in research, despite the high prevalence in perinatal women, and potential

adverse impacts on mothers, their babies, and their families. The limited information of perinatal MI further indicates the necessity and importance of better understanding of MI in perinatal women.

1.12 Goals and objectives of the study

The overall goals of this dissertation were to review perinatal MI systematically, and to understand perinatal MI by assessing its risk factors, and its effects on neonatal outcomes across the perinatal period: early pregnancy, late pregnancy, and postpartum, as well as to determine whether the psychometric properties of ALS-18 was a useful instrument for measuring MI in perinatal women.

This dissertation includes four manuscripts that are related to perinatal MI. The objectives of each study were formulated based on an extensive literature search and the expertise of the Ph.D. student's supervisor, and advisory committee members. The objectives were presented in the studies as research question, or research hypothesis.

Chapter 2 is manuscript one. The research question was "What is the state of the literature related to perinatal MI, its relation to perinatal depression, and its effects on children?" Manuscript one systematically reviews the currently available publications on perinatal MI. The review used the PRISMA guidelines for reporting systematic reviews (Moher, Liberati, Tetzlaff, Altman, & PRISMA Group, 2009) and the Critical Appraisal Skills Program (CASP) tools were used for assessing the quality of articles (CASP, 2017).

Chapter 3 is manuscript two. The research hypothesis was "Perinatal MI would be associated with its risk factors at early pregnancy, late pregnancy, and postpartum, antenatal MI would be correlated with PPD, and perinatal MI would have its distinct trajectory." Manuscript two examines risk factors for MI at early and late pregnancy, and postpartum cross-sectionally, the association between antenatal MI at early and late pregnancy and PPD, and trajectory of perinatal

MI across the perinatal continuum. A total of 648 women participated in this longitudinal study of maternal depression at three points: early pregnancy (T1, 17.4 ± 4.9 weeks), late pregnancy (T2, 30.6 ± 2.7 weeks), and postpartum (T3, 4.2 ± 2.1 weeks). Mood instability, depression, stress, and social support were measured at T1, T2, and T3, other sociodemographic data were collected at T1, and obstetrical information was obtained at appropriate times. Multi-linear regression was used to examine MI and its risk factors cross-sectionally, hierarchical multiple regression was used to investigate longitudinal relationship between antenatal MI and PPD, and a linear mixed effect model was employed to examine the trajectory of perinatal MI over three periods (T1-T3).

Chapter 4 is manuscript three. The research hypothesis was "Antenatal MI, depression, and anxiety would be associated with neonatal outcomes (low BW, SGA, preterm birth, low 1-minute and 5-minute Apgar score) at 17 weeks and 31 weeks pregnancy". Manuscript three investigates whether antenatal MI, depression, and anxiety are risk factors for adverse neonatal outcomes. A total of 555 women participated in a longitudinal study of maternal depression at two points: early pregnancy (T1, 17.4 ± 4.9 weeks), and late pregnancy (T2, 30.6 ± 2.7 weeks). MI, depression, anxiety, psychosocial, and behaviour variables were measured at T1 and T2, other social demographic data were collected at T1, and obstetrical and neonatal information was obtained at appropriate times. Binary logistic regression was utilized in this study.

Chapter 5 is manuscript four. The hypothesis of this study was "The ALS-18 would be a valid instrument in measuring affective lability in pregnant and postpartum women with mood symptoms". A confirmatory factor analysis was conducted on three models in the total sample to evaluate model fit. Manuscript four evaluated the psychometric properties of ALS-18 in perinatal women with various mood symptoms. A total of 113 pregnant and postpartum women participated in this study. Confirmatory factor analyses were performed to compare the fit of alternative models.

Finally, Chapter 6 includes the overview of dissertation objectives, implications, contributions of this research, areas for future research, limitations, and conclusions.

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Chapter 2: Manuscript One

Mood instability during pregnancy and postpartum: A systematic review

Abstract

Background: Perinatal mood instability (MI) is a common clinical observation in perinatal women and existing research indicates that MI is strongly associated with a variety of mental disorders. **Objective**: To review the evidence of perinatal MI systematically, with a focus on perinatal MI, its relation to perinatal depression, and its effects on children. **Methods**: A systematic search of the literature was conducted on seven academic health databases to identify any peer-reviewed articles published in English from 1985 to July 2017. Studies were screened, data were extracted, and quality was appraised. **Results**: A total of 1,927 abstracts were returned from the search, with 1,063 remaining for abstract screening after duplicate removal, and seven studies were selected for final analysis. The selected articles included quantitative (n = 5) and qualitative (n = 2) studies. No reviews were retrieved. The articles addressed perinatal MI (n = 2), the relation of perinatal MI to perinatal depression (n = 4), and the effects of perinatal MI on children (n = 1). Studies identified that perinatal women are moodier than non-perinatal women, MI is a prominent feature in perinatal women with and without depression, mood lability during the early postpartum predicts psychopathology up to 14 months postpartum, and maternal emotion dysregulation, rather than maternal psychopathology, increases the risk of heightened facial affect synchrony in mother-infant interaction. **Conclusion**: The study reveals a significant gap in the literature of perinatal MI.

Keywords: Pregnancy; postpartum; perinatal women; mood instability

2.1 Introduction

Being pregnant and giving birth to a baby can be joyous and exciting times for a woman, however, the transition to motherhood can also bring many challenges both physical and emotional that can impact maternal and child health outcomes (Dayan et al., 2002; Li, Liu, & Odouli, 2008; Nelson, 2003). Some women may experience mood disturbances, depression, or anxiety during the perinatal period, but mood instability (MI) can also be distressing for pregnant and postpartum women (Bowen, A., Bowen, Balbuena, & Muhajarine, 2012; Kessler et al., 2003; O'Hara & Wisner, 2014).

Mood instability is defined as extreme shifts in mood that last from a few hours to a few days (Koenigsberg et al., 2002). The term MI is sometimes used interchangeably with mood swings, affect instability, or emotional dysregulation (Marwaha et al., 2014). MI has been associated with women during various stages of their reproductive years, such as menstruum, pregnancy, and postpartum (Bowen, A. et al., 2012; Bowen, R, Bowen, Baetz, Wagner, & Pierson, 2011; Mitchell, 2017). The mood changes often seen in perinatal women have been attributed to the high hormonal fluctuations that occur during this time (Cunningham et al., 2010). Mood lability in the early postpartum has been discussed under the concept of postpartum blues (PPB) or maternity blues (Kennerley, Helen & Gath, 1989; O'Hara, Schlechte, Lewis, & Wright, 1991). Postpartum blues has been described as a transient disturbance in mood occurring in 40-80% of new mothers (Kennerley, H. & Gath, 1985; O'Hara et al., 1991; Steiner, 1998). Symptoms typically begin within the first few days after delivery and resolve without requiring medical or psychological treatment by day 10 or longer. The PPB are most commonly characterized by dysphoric mood, irritability, emotional lability, tearfulness, anxiety, sleep disturbance, and lack of concentration (Kennerley, H. & Gath, 1985; O'Hara et al., 1991). The phenomenon of rapidly

changing moods is often viewed as a harmless or normal part of a woman's life (Steiner, Dunn, & Born, 2003).

Studies of MI in general populations and clinical samples have shown a strong association of MI with a variety of psychiatric disorders including depression, anxiety, and personality disorders (Bowen, R., Baetz, Hawkes, & Bowen, 2006; Marwaha, Balbuena, Winsper, & Bowen, 2015; Thompson, Berenbaum, & Bredemeier, 2011). Marwaha et al. (2015) investigated whether MI at intake was associated with the new inception of depression at follow-up by removing participants with depression at baseline, and found MI to be a precursor to depression. Literature examining the relationship between MI and psychological distress speculates that having an inability to manage intense physiological arousal, difficulties identifying emotions, and experiencing conflictive emotions are related to psychological distress (Ebner-Priemer et al., 2008; Stiglmayr, C. et al., 2005; Stiglmayr, C., Shapiro, Stieglitz, Limberger, & Bohus, 2001), which may lead to interpersonal difficulties that cause stressful life events (e.g., the break-up of a relationship, loss of a job) (Koenigsberg et al., 2002).

Studies suggest that maternal psychiatric disorders obstruct the interaction between mother and infant (Field, 2010; Martinez-Torteya et al., 2014). In regards to the relationship between maternal emotional dysregulation and child outcomes, studies suggest that mother-infant interaction is a dynamic process that is mutually regulated by their behaviours (Schmidt & Richardson, 2008; Sroufe, 2013). One essential attribute of the process is synchrony, which reflects the temporal coordination of behaviour between mother and infant (Bernieri & Rosenthal, 1991). Jaffe et al. (2001) indicate that facial affect synchrony in infant-mother interaction at a moderate level prompts a natural and appropriate interaction between mother and infant, whereas a heightened and lowered level of facial affect synchrony create an impediment in infant development. Beebe et al. (2008) found that mothers with higher maternal depressive symptoms

showed a heightened level of facial affect synchrony when interacting with their infants in comparison with mothers with lower depressive symptoms.

The present lack of research of perinatal MI may be partly due to the normalization of perinatal MI and the tendency for investigators to examine diagnosable entities, such as depression and anxiety.

2.2 Research question

What is the state of the literature related to perinatal MI, its relation to perinatal depression, and its effects on children?

2.3 Methods

Since there is limited research on perinatal MI, this study conducted a systematic review of existing literature published between January 1985 and July 2017 (a period of over 30 years). The review used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for reporting systematic reviews (Moher, Liberati, Tetzlaff, Altman, & PRISMA Group, 2009) and the Critical Appraisal Skills Program (CASP) tools were used for assessing the quality of articles (CASP, 2017).

2.3.1 Search strategy and inclusion and exclusion criteria

Seven academic health databases were searched by a health sciences librarian and a Ph.D. student (HL) including PUBMED, MEDLINE, PsycINFO, CINAHL, EMBASE, Scopus, and Cochrane Library (Cochrane Database of Systematic Reviews). Search terms were developed in consultation with the health sciences librarian, a co-researcher, and a psychiatrist who specializes in mood disorders, and covered the relevant domains: perinatal women, and MI. The search strategy included MEDLINE MeSH headings and keywords that were relevant to pregnancy (pregnan*, OR pregnant women, OR pregnancy outcome*, OR pregnancy trimester*, OR prenatal, antenatal, OR gestation*, OR antepartum), OR child birth/postpartum (labour*, OR labor*, OR

parturition, OR childbirth, OR birth, OR deliver*, OR postpartum, OR postnatal, OR puerperium, OR puerperal), OR perinatal (matern*, OR perinatal, OR childbearing, OR mother*), AND mood instability (mood instability, OR mood dysregulat*, OR mood lability, OR mood swings, OR affect* instability, OR affect* dysregulat*, OR affect* lability, OR emotion* instability, OR emotion* dysregulat*, OR emotion* lability). The three search strings were combined using the Boolean operators OR and AND. Two additional articles were also identified by a reviewer before the manuscript peer-review process. The search strategy and search terms used in the search can be found in Appendix 2-A.

The inclusion criteria were any studies using quantitative or qualitative or mixed methods, including literature review, systematic reviews, or meta-analysis, or meta-syntheses that were published between January 1985 and July 2017 (search was conducted between July 15 and August 1, 2017). Articles were not included if they were not published in English or if they were not peer-reviewed publication (e.g., grey literature).

2.3.2 Screening and selection

HL and a trained research assistant (RA) independently screened titles and abstracts of articles for the search terms to identify relevant articles. There was a high level of agreement (82%) between HL and RA. Any disagreements were resolved by discussion. If an article's abstract was not available, but the title appeared relevant, the full article was retrieved. The review of full-text articles, which were retained at the stage of screening title and abstract, was carried out to determine the relevance by HL and the RA. Any discrepancies between HL's and RA's results at this stage were discussed to reach an agreement. After the review process, the studies that passed the review proceeded to quality appraisal and data extraction.

2.3.3 Quality appraisal and data extraction

The Critical Appraisal Skills Program (CASP) tools were used for assessing study quality (CASP, 2017). The quality appraisal of each study was evaluated independently by two of the authors. The CASP checklist contains 10 questions for both quantitative and qualitative studies, which can be scored "yes," "no" or "cannot tell." A "yes" score indicates that the study meets the criteria, a "no" means that the study did not meet the criteria, and "cannot tell" indicates that insufficient information was provided. The potential maximum score on the list is 10. The total score is the sum of all the criteria which are scored "yes," "no" or "cannot tell" scores are not subtracted. We chose to consider a study of "high quality" when it scores more than 80.0%, "moderate" (60.0 to 80.0%), and "weak" (<60.0%) (Kuijpers, van der Windt, van der Heijden, & Bouter, 2004; Legere et al., 2017).

Data extraction was performed using a table for each study and included information on the study's quality score, author, year, objective, design, methods, sample, setting, analysis, outcome measures, results, strengths, limitations, implications, and conclusion (Marwaha et al., 2014). Data extraction was carried out by reviewing the full-text article.

2.3.4 Data synthesis

Given the heterogeneity of the included qualitative studies, we used a narrative approach to data synthesis. We categorized articles into groups based on the focus of perinatal MI, or perinatal MI in relation to perinatal mood disturbances, or effect of perinatal MI on children. The narrative description included the category name, the generalizability of the findings, any conflicting results or conclusions.

2.4 Results

2.4.1 Study selection

A total of 1,925 articles were identified from a search of seven selected databases based on the pre-specified limits. Two additional articles were submitted by members of the research team after the search was completed (n = 1,927). After removing duplicates, 1,063 articles were screened for title and abstract. Of 1,063 articles, 18 articles were perinatal mood-related, and were assessed further for eligibility. After reviewing the full articles for eligibility, seven articles were included in the quality appraisal, data extraction, and categorization process. The seven selected articles had a central theme of perinatal MI, perinatal MI in relation to perinatal mood disturbance, or effect of perinatal MI on children. A PRISMA flow diagram presents all phases of the review (Figure.2.1) (Moher et al., 2009).

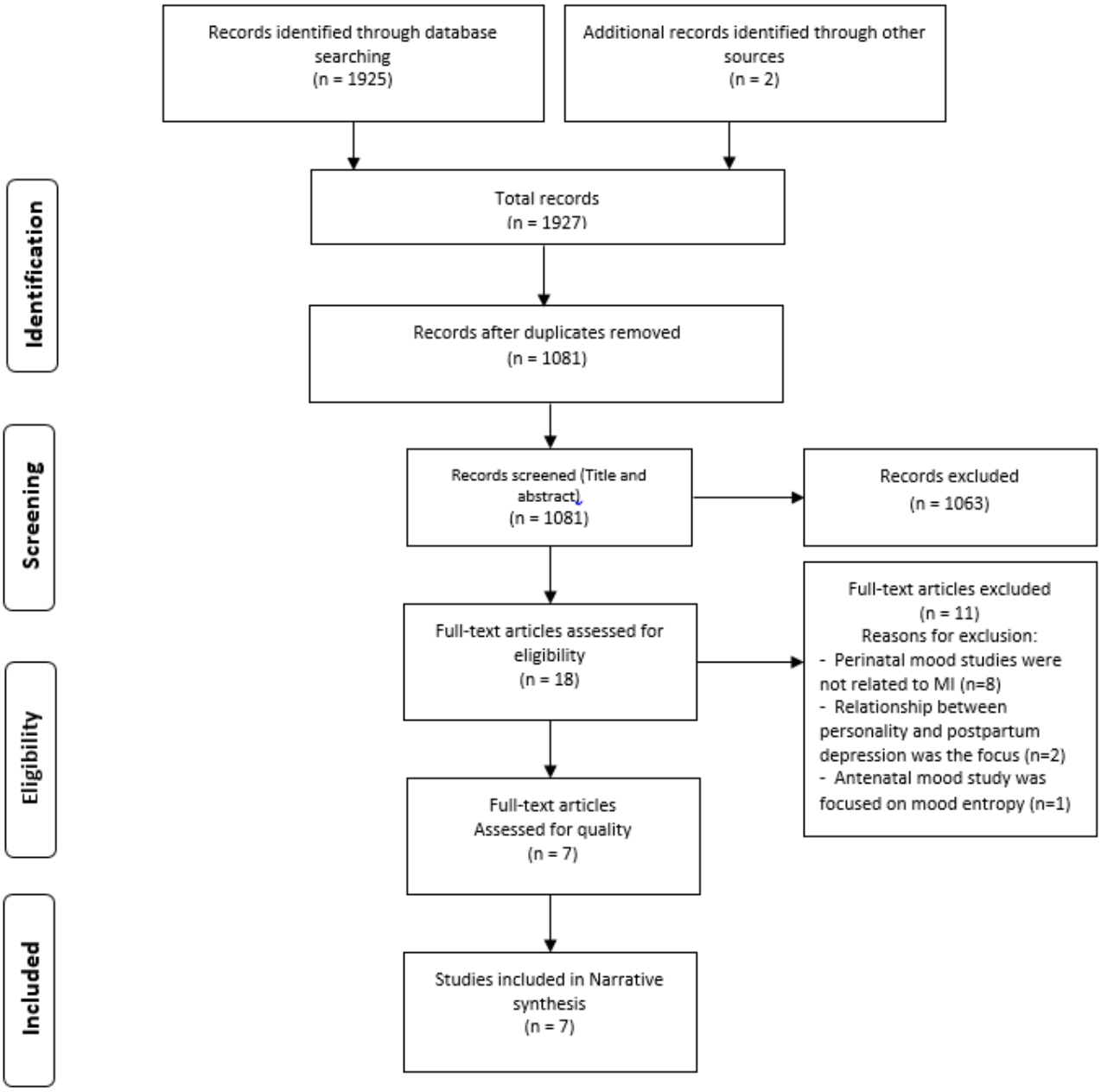

Figure 2.1. PRISMA flow diagram showing study selection process

2.4.2 Summary of study characteristics

All seven studies were published between 1988 and 2016. The studies were located in Canada (Bowen, A. et al., 2012), the US (Beck & Indman, 2005), Germany (Lotzin, Schiborr, Barkmann, Romer, & Ramsauer, 2016), Australia (Wilkinson, 1999), New Zealand (Hapgood, Elkind, & Wright, 1988), Taiwan (Tseng, Hsu, Liu, & Chen, 2008), and Singapore (Ong et al., 2014). All of the studies were conducted in, or involved hospital or community settings (primary care sites or participants' homes). The research designs were varied in the seven studies, with the majority of the studies being quantitative (n = 5) and two qualitative studies. The study designs included cross-sectional (Beck & Indman, 2005; Lotzin et al., 2016), longitudinal prospective (Bowen, A. et al., 2012; Hapgood et al., 1988; Wilkinson, 1999), and two qualitative studies (Ong et al., 2014; Tseng et al., 2008). No reviews, randomized controlled trials, or mixed methods studies were retrieved.

A total of 452 women, 86 partners, and 68 children were involved in the seven studies, with sample sizes ranging from 12 to 172. Various measures for MI were used including the Visual Analogue Scale (VAS) (Bowen, A. et al., 2012; Hapgood et al., 1988), the Emotion Regulation Scale (Lotzin et al., 2016), the Positive and Negative Scale (Wilkinson, 1999), the Postpartum Depression Screening Scale (PDSS) (Beck & Indman, 2005), and semi-structured interviews (Ong et al., 2014; Tseng et al., 2008). The VAS used in Bowen, A. et al. study (Bowen, A. et al., 2012) included a five items: 1 "mood frequent ups and downs", 2 "mood swings occur for no reason", 3 "other people complain about your mood swings", 4 "having trouble following through with plans because of mood swings", and 5 "not making commitments because moods might change". Women were asked to mark an "X" on with a 10cm line. The X was then measured on a metric ruler by a research assistant. This self-reported measure has a total possible score of 50. Hapgood et al., (1988) used a VAS that contained six mood scales: 1 "I am feeling happy and self

confident", 2 "I am feeling miserable and depressed", 3 "I have been in tears", 4 "I am very worried and anxious", 5 "I am very irritable and quick tempered", and 6 "my spirits are going up and down like a yoyo". The VAS used by Hapgood et al. (1988) had a similar measure as Bowen, A. et al. study, and has a total possible score of 60.

Four studies included postpartum women (Beck & Indman, 2005; Hapgood et al., 1988; Lotzin et al., 2016; Ong et al., 2014), one study included only pregnant women (Tseng et al., 2008), and two studies followed women through their pregnancy to postpartum (Bowen, A. et al., 2012; Wilkinson, 1999) (Appendix 2-B Table 2-B.1).

Based on the score of the quality appraisal, one quantitative study was rated as weak (Beck & Indman, 2005), three quantitative studies were rated as moderate (Bowen, A. et al., 2012; Hapgood et al., 1988; Wilkinson, 1999), and one quantitative study (Lotzin et al., 2016) and two qualitative studies (Ong et al., 2014; Tseng et al., 2008) were rated as strong. The weak rating was mostly attributed to insufficient descriptions of data analysis and methods of data collection. The quality appraisal ratings can be found in Appendix 2-B, Table 2-B.1.

2.4.2.1 Quantitative studies

In a longitudinal study, Bowen, A et al. (2012) examined whether perinatal women are moodier than non-perinatal women. A subgroup of 45 perinatal women participated in this study from the Feelings in Pregnancy and Motherhood Study (Bowen, A., Bowen, Butt, Rahman, & Muhajarine, 2012). Co-currently, a control group comprised of normally menstruating non-perinatal women without depressive symptoms (n = 31) from a separate study of moods was also recruited (Bowen, R, Mahmood, Milani, & Baetz, 2011). The perinatal women were interviewed at early pregnancy (mean gestation 16.4 weeks, SD 4.4), late pregnancy (mean gestation 30.4 weeks, SD 2.3), and postpartum (mean 4.3 weeks postpartum, SD 1.5). Mood instability was measured by using mood diaries with visual analogue scales (VAS) for depressed, irritable, anxious, and

euphoric moods for both groups in the morning and evening. Depression symptoms were assessed by using the Edinburgh Postnatal Depression Scale (EPDS) (Cox, Holden, & Sagovsky, 1987). The perinatal women completed three separate mood diaries (each for seven days) after three interviews, while the control group completed the mood diaries for two consecutive menstrual cycles (eight weeks). Mood instability for both groups was assessed with the mean square successive difference (MSSD) statistic derived from the serial VAS ratings, and the linear mixed modeling procedure was used to examine the trajectory for MI over three periods. The study found that moods of perinatal women were more widely fluctuated than moods of non-perinatal women regarding depressed, irritable, anxious, and euphoric mood fluctuation, indicating that perinatal women are moodier, while the findings held when depressed perinatal women were removed from the comparison except for depressed mood of the VAS, suggesting that perinatal women without depressive symptoms still experienced a higher level of MI than the control group. In addition, contrary to the view of dysphoric mood in pregnancy and postpartum women, the study found that MI is a prominent feature in women during the perinatal period. There are several strengths of this study. First, it is the first study of perinatal MI. Second, it has a control group which serves as a baseline to evaluate what effects perinatal period has on women's mood. Third, the study utilized the MSSD that determine point-to-point variability of mood and also takes into account the temporal order of ratings (Jahng, Wood, & Trull, 2008). The small sample size of the study limits the generalization of the findings.

In the article entitled "The many faces of postpartum depression," Beck and Indman (2005) aimed to provide a profile of women with postpartum depression (PPD) by using the Postpartum Depression Screening Scale PDSS (Beck & Gable, 2002). PDSS includes seven dimensions: sleeping/eating disturbances, anxiety/insecurity, emotional lability, mental confusion, loss of self, guilt/shame, and suicidal thoughts. In this cross-sectional study, the data was collected from private

practice in the San Francisco Bay Area of the US, and 133 women with PPD participated the study. The women completed the PDSS and a Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV) diagnostic interview at 16 mean weeks of postpartum. Anxiety and irritability were found to be prominent elements of PPD, but emotional lability was the dimension that obtained the highest mean total score, and irritability is a component of emotional lability. The authors indicated that "depression is not necessarily the first or most important symptom of mothers suffering from postpartum depression," (p. 570) suggesting that depression in women with PPD does not display as a uni-dimensional mood symptom, rather it is a multi-dimensional mood manifestation that includes emotional lability, anxiety, and irritability. The study conducted descriptive data analysis only, used means of all seven dimensions to make conclusions, and did not take confounders into consideration, and was therefore rated as weak in the quality appraisal.

In another longitudinal study, Hapgood et al. (1988) investigated the relationship between PPB in the early postpartum and later psychopathology. Sixty-six women from six antenatal clinics at the National Women's Hospital in New Zealand participated in the study. Mental health status was assessed using the Goldberg semi-structured psychiatric interview at 36 weeks pregnant and at 3 weeks, 3 months, 6 months, and 14 months postpartum (Goldberg, Cooper, Eastwood, Kedward, & Shepherd, 1970), and mood fluctuations were assessed using a VAS which included six mood scales (happiness, depression, tears, anxiety, irritability, and lability). Women rated their moods over the past 24 hours on each scale at the same time each day (early evening) from the first one of giving birth to the 14th day of postpartum. The study found that emotional lability during the early postpartum was an essential component of the PPB. The factor analysis of the VAS data suggests that emotional lability is a separate factor that indicates "mood going up and down" as an independent phenomenon. Longitudinally, emotional lability during the early postpartum was the most important predictor of later psychiatric symptoms up to 14 months postpartum, indicating that

women who experience elevated lability of mood during first two weeks of postpartum may be at risk of later depression. Generalization of the findings may be limited due to relatively small sample size.

Wilkinson (1999) examined mood changes in 86 perinatal women (44 multiparous and 42 primiparous) and their partners recruited from a public hospital in Australia. To assess mood lability at the second and third trimesters, and at ten days and three months postpartum, women were asked to rate to what extent their mood had fluctuated during the past week using a five-point scale (1 = very stable; 5 = very changeable). The Positive and Negative Affect Scale (PANAS) (Watson, Clark, & Tellegen, 1988) was used for measuring mood states. Positive affect was found to be significantly higher at ten days and three months postpartum than the second trimester. When compared to the second trimester, negative affect was higher in the third trimester, and ten days and three months postpartum. In regards to parity, multiparous reported significantly higher levels of negative affect in the third trimester than primiparous. However, at day ten of postpartum there was no significant difference between multiparous and primiparous. Mood lability did not vary much over the study period except women having their first child. Primiparous showed significantly increased mood lability from the third trimester to the ten-day postpartum. Overall, the study suggests that mood in perinatal women cannot simply be characterized as a negative state, rather a modest overall increase in positive affect from the second trimester to postpartum, suggesting that mood experience can be characterized as a mixed mood state for perinatal women. The mood lability data from this study also support that the impact of childbearing on women's moods is more pronounced for first-time mothers. Several strengths of the study were indicated. The study included both first-time mothers and mothers with one or more children, and found that the mood experienced by first-time mothers may be different from experienced mothers. Second, it investigated perinatal women's mood using PANAS as an instrument, which is widely used in the

self-report mood studies (Diener, Kanazawa, Suh, & Oishi, 2015; Diener et al., 2010). By utilizing both measures (PANAS and MI questionnaires) to assess women's mood, the importance of understanding the etiology and characteristics of mood symptoms during perinatal period is underscored (Buttner, O'Hara, & Watson, 2012). The study did not specify the mood lability scale used; it is unknown what mood symptoms were assessed and how many questions were asked. A relatively small sample size restricted the generalization of the findings.

Studies found that maternal psychiatric disorders obstruct the interaction between mother and infant (Field, T., 2010; Martinez-Torteya et al., 2014). For example, mothers with higher maternal depressive symptoms showed a heightened level of facial affect synchrony when interacting with their infants in comparison to mothers with lower depressive symptoms (Beebe et al., 2008). Lotzin et al. (2016) examined whether maternal emotion dysregulation was associated with mother-infant facial affect synchrony. The cross-sectional study included 68 mothers and their infants aged 4-9 months from a psychiatric mother-infant outpatient unit in Germany; all mothers were diagnosed with a variety of mood disorders according to the DSM-IV (88.2% major depression, 4.4% of bipolar, 4.4% of dysthymia, 2.9% adjustment disorder with depressed mood). Measuring mother-infant interaction was through observation using the Still-Face paradigm during two play interactions (Tronick, Als, Adamson, Wise, & Brazelton, 1978), and facial affect of mother and infant was rated from high negative to high positive, and a time-series analysis was computed to assess the degree of synchrony between the mother's and infant's facial affect. It also used a comparison group of babies who were not related to mothers as a baseline level of facial affect synchronization. The Difficulties in Emotion Regulation Scale was used to assess maternal emotion dysregulation (Gratz & Roemer, 2004), and maternal mood disorders were evaluated by the Symptom Checklist-90-Revised (Franke, 2002). The study found that emotion dysregulation in mothers with mood disorders was significantly associated with mother-infant facial affect

synchrony after controlling for maternal psychopathology, infant gender, and age. The authors suggested that a heightened mother-infant facial affect synchrony was most likely induced by the mother's overreactivity, which indicates distress and hypervigilance (Beebe et al., 2008) that probably hinders the infant's developing abilities to self-regulate and to explore (Bornstein & Manian, 2013). Strengths of the research include utilizing a comparison group as a baseline in the study design, and a time-series analysis was used to analyze the level of facial affect synchronization in mother-infant interaction. The study suggests that mothers with psychiatric disorders would benefit from emotion regulation training including the importance of mother-infant facial synchrony, indicating that interaction between mother-infant could be improved through education.

2.4.2.2 Qualitative studies

In a qualitative study exploring first-time mother's postnatal experience and support needs after hospital discharge in Singapore, a purposive sample of 13 mothers was recruited, and a semi-structured interview was conducted at 10-14 days of postpartum (Ong et al., 2014). Participants' age ranged from 21 to 39 years old, and there were six Chinese, two Malay, two Indian, two Caucasian, and one Burmese woman. There was one single mother, and only two mothers attended prenatal classes. Different financial backgrounds were reported as monthly family income ranged from $800 US to more than $4,000 US. Upon analysis, five themes emerged: negative emotions (anxiety, labile emotion, and stress), breastfeeding concerns (low breast milk supply and physical discomfort), social support, postnatal cultural practice, and professional support needs. The study found that emotional issues were prevalent in mothers, and while some mothers expressed happiness, negative feelings were common across all interviews. In addition, mothers experienced episodic crying spells and labile emotions during this period, and in the severe cases, emotional lability was related to inability to cope with infant care, and difficulties sharing emotional issues to

others because the women did not perceive that it was serious enough or their relatives lacked knowledge of postpartum emotional issues. However, in this study participants' mental health assessment was not conducted before the interviews, which may not provide a more comprehensive view of women's experiences in regards to understand women's emotional issues, and the relationship between mental health and emotional issues or distress.

Tseng et al. (2008) explored the experience of prenatal depression in an in-depth interview of 12 depressed pregnant women at their 2nd or 3rd trimester of pregnancy (EPDS ≥ 15) in Taiwan. Women were recruited from prenatal clinics at two teaching hospitals, were aged from 19 to 33 years old. Seven women had a college or higher level of education and the rest of the women graduated from high school. All women were married, four were first-time mothers, and five had planned pregnancies, while seven were unplanned pregnancies. Five were employed, and eight were of middle socioeconomic status (SES), while two were low SES and two were high SES. Two women reported having a history of depression. From the interviews, five themes were identified: emotional instability, uncertainty of future, lack of social support, multiple conflicting roles, and dissatisfaction with body image. The findings indicate that pregnant women often experience emotional ups-and-downs by expressing feelings of being emotionally fragile, sensitive, impatient, and easily angered. Furthermore, women also overreacted to small things while also feeling depressed and tended to cry spontaneously for unknown reasons. In addition, the study suggests that emotional instability is connected with feelings of burdened by the increased work load, constant fatigue and reduced energy level during pregnancy. First time mothers described that they lose their temper easily due to discomfort caused by pregnancy, and multiparous mothers were particularly anxious to avoid repeating previous negative experiences. The study could conduct a follow-up interview to provide women the chance to add on information, and also give researchers opportunity to ask questions based on the first interview.

2.5 Discussion

The purpose of this systematic review was to synthesize the evidence of MI in pregnant and postpartum women, its relation to perinatal depression, and its effects on children. Our review found seven articles of weak, moderate, and strong quality according to CASP, and none of these articles were reviews. Only two studies investigated perinatal MI, one examined the relationship between maternal emotion dysregulation and facial affect synchrony in mother-infant interaction, and rest of studies found MI as a component of PPB, PPD, or experience of pregnant women. Nevertheless, the findings suggest that MI is a prominent feature in perinatal women, MI in the early postpartum is an important predictor for late psychopathology up to 14 months postpartum, and maternal emotion dysregulation impedes child development. Although selected studies confirmed that women experience elevated MI in pregnancy and postpartum, its etiology and risk factors, the relationship between perinatal MI and other mood disorders, and between perinatal MI and neonatal and child outcomes are still unknown.

2.5.1 Suggestions for future work

To better understand MI in pregnant and postpartum women, future quantitative research could include examining the risk factors for perinatal MI, and the predictability of antenatal MI for postpartum MI. Although mood lability during the early postpartum was found to be associated with late psychopathology up to 14 months postpartum, based on the evidence that women experience MI through the entire perinatal period, the investigation of the relationship should be expanded from early pregnancy to late postpartum. The relationship between antenatal MI and postpartum psychopathology including depression, anxiety, and bipolar disorders, and between antenatal MI and maternal birth outcomes should be examined. To further unravel perinatal MI, future research could include women who are pre-conceptual and subsequently become pregnant to

identify the risk factors before pregnancy associated with perinatal MI. In regards to the relationship between perinatal MI and neonatal and child outcomes, future studies could investigate whether perinatal MI is associated with adverse neonatal and child outcomes.

In qualitative studies, perinatal MI was described as one element of women's perinatal experience. Future research in qualitative studies could explore women's lived experiences of perinatal MI to understand MI further, its risk factors, and women's perception of how to alleviate MI symptoms such as social support, coping skills, and what kind of health care services would help them. The rich and comprehensive content from qualitative research would provide valuable information in terms of understanding women's perspective, lived experience of MI, and ultimately improve women's quality of life.

2.5.2 Implications

This current review has several implications. Increased education and awareness of perinatal MI are necessary for both the general population and for health care professionals. Clinicians need to be alert to the range of symptoms of perinatal MI to identify women suffering in silence from mood fluctuation assumed as normal part of women's life. Not every mother will present with the same constellation of symptoms (Bowen, A.et al., 2012; Ong et al., 2014; Tseng et al., 2008). It is important to screen all pregnant and postpartum women, because many women with MI may outwardly appear to be doing well or women may believe that MI is normal for them. Routine screening for perinatal MI should be included in the routine perinatal care. Although instruments of assessing MI have been developed and validated in general and clinical population, measurements of evaluating MI for pregnant and postpartum women have not been developed or validated, which indicates that a valid instrument for assessing perinatal MI should be in place for the routine screening. Once an accurate assessment has been made, therapeutic interventions can be established to address and alleviate the symptoms.

In addition, it is essential for health care professionals to recognize the potential risk factors that may be linked to emotional lability. For example, Tseng et al. (2008) suggest that culturally-influenced distress plays a role in emotional lability. For example, in Chinese culture, the women's in-laws expect the couple to have a baby soon after marriage, and also prefer that the child is a boy to extend the family line, which puts considerable pressure on women (Tseng et al., 2008). However, Ong et al. (2014) studied a diverse group of first time mothers from different ethnic backgrounds, and found that all first time mothers are vulnerable to emotional distress cross-culturally.

In regards to inability to cope with the emotional issues, education on coping strategies with infant care, and coping skills incorporated with interpersonal psychotherapy among perinatal women should also be included as a component in perinatal classes (Ong et al., 2014). Social support has been recognized as a risk factor for emotional issues in both qualitative studies, suggesting more support from women's social network and professionals, and fostering coping resources are required to alleviate emotional lability (Tseng et al., 2008).

2.6 Limitations

The main limitation of this review is the relatively sparse amount of studies and literature about MI, particularly in perinatal women. Only seven of the retrieved research studies were relevant to our research question, and several were not current (within ten years). Different instruments were used for measuring MI in the studies, most of which were not validated in perinatal women. The timing of assessment of MI ranged widely across the perinatal period. Reviewed studies all relied on the mothers' retrospective self-reports, which may cause recall bias (Schwartz & Rapkin, 2004). Overall, these factors limit the generalizability of our findings. Another limitation is the inclusion of peer-reviewed articles only in English.

2.7 Conclusion

As the first known systematic review of MI in pregnant and postpartum women, this review adds to the scientific evidence of perinatal MI, its relation to perinatal depression, and its effect on child outcomes. A significant gap of research in perinatal MI has been uncovered. The reviewed literature reveals that perinatal women are moodier, mood lability during early postpartum predicts psychopathology up to 14 months of postpartum, the mood experienced by first-time mothers may be different from experienced mothers, and higher maternal emotional dysregulation is associated with heightened mother-infant facial affect synchrony. The association between MI in the early postpartum and subsequent psychopathology indicates that it is essential to screen MI during early postpartum. However, perinatal MI is clearly understudied. Future research should investigate the relationship between MI and other mood disorders throughout perinatal period, not just during the early postpartum, explore risk factors for perinatal MI, and the relationship between perinatal MI and neonatal outcomes. To ensure optimal quality of perinatal mental health, education and promotion of perinatal MI in the general population and health care professionals are necessary, and routine screening for MI should be a part of perinatal care to ensure early detection and early intervention.

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Appendix 2-A: Search strategy and search terms

Search strategy

Database Search

A systematic search for recent literature relevant to perinatal mood instability (MI) was conducted by a health sciences librarian and a PhD student.

List of Databases Searched: Seven databases were searched: Cumulative Index to Nursing and Allied Health (CINAHL), Cochrane Library (Cochrane Database of Systematic Reviews and Cochrane Central Register of Controlled Trials), Embase, PUBMED, MEDLINE, PsychINFO, and Scopus.

***Research Question*:** What is the state of the literature related to perinatal MI, its relation to perinatal depression, and its effects on children?

Inclusion Criteria

The following criteria were used to guide the search:

- A primary focus of the article is on the topic area: MI in pregnant women or women with a newborn or infant less than 24 months, MI in relation to perinatal mood disturbances, and effects of perinatal MI on children
- Study methodology limited to all types of primary studies: quantitative, qualitative, mixed methods, and reviews
- Published between January 1985 and July 2017
- Published in English
- Accessible for retrieval

Exclusion Criteria

The following criteria were used to exclude literature from the search:

- Topic not related to perinatal MI or in relation to perinatal MI (e.g., antennal and postpartum depression, and antenatal and postpartum anxiety only, etc.).
- Dissertations, commentaries, narrative, anecdotal articles, letters to the editor, editorials, expert reports, consensus documents, discussion papers
- Non-English studies
- Unpublished (e.g., grey literature)
- Studies involving animals
- Articles focusing only on antenatal and postpartum depression, and antenatal and postpartum anxiety

Search Terms

Below are condensed search terms used in MEDLINE. Comparable terms were used in the additional databases searched

Antenatal, postpartum, and perinatal		Mood instability	Limits Applied
OR		OR	
1-Birthing [mesh:noexp]/ maternity [embase] 2-Delivery, Obstetric[mesh:noexp] 3-Maternal Health Services[mesh:noexp] 4-Reproductive Health services[mesh:noexp] 5-Pregnan*[tiab] 6-Labour*[tiab] 7-Labor*[tiab] 8-Midwifery[mesh:noexp] 9-Nurse Midwives[mesh:noexp] 10-Midwi*[tiab] 11-Pregnancy[mesh:noexp] 12-Pregnant Women[mesh:noexp] 13-Parturition[mesh:noexp]/birth[embase] 14-Parturition[tiab] 15-Postnatal Care[mesh:noexp] 16-Pregnancy Outcome[mesh:noexp] 17-Pregnancy Trimesters[mesh] 18-Pregnancy in Adolescence[mesh:noexp] 19-Pregnancy, High Risk[Mesh:noexp] 20-Pregnancy, Multiple[Mesh:noexp] 21-Pregnancy, Unplanned[Mesh:noexp] 22-Pregnancy, Quintuplet[Mesh:noexp] 23-Pregnancy, Quadruplet[Mesh:noexp] 24-Pregnancy, Triplet[Mesh:noexp] 25-Pregnancy, Twin[Mesh:noexp] 26-Prenatal care[mesh:noexp] 27-Prenatal[tiab] 28-Antenatal[tiab] 29-Perinatal Care[mesh:noexp] 30-Perinatal[tiab] 31-Child bearing[tiab] 32-Childbearing [tiab] 33-Deliver*[tiab] 34-Expect*[tiab] 35-Intrapartum[tiab] 36-Matern*[tiab] 37-Mothers[mesh] 38-Mother*[tiab] 39-Postpartum[OT] 40-Postnatal[OT] 41-Pregnancy[OT] 42-Perinatal[OT] 43-Antenatal[OT] 44-Labor, Obstetric[mesh] 45-puerper*[tiab] 46-or/1-45	**A N D**	47-(mood adj2 (instab* or dysregulat* or lability)).tw. 48-(affect* adj2 (instab* or dysregulat* or lability)).tw. 49-(emotion adj2 (instab* or dysregulat* or lability)).tw. 50-(blues adj2 (matern* or baby or postpartum or postnatal)).tw. 51-or/47-50 52-46 and 51	53-limit 52 to human and English language 54-limit 53 yr="1985 - Current"

Appendix 2-B: Table of characteristics of included studies

Table 2-B.1: Characteristics of included studies (n = 7)

Author (year), Country	Study design	Sample size	Measures	Time points		Major findings	Quality rating*
				Antenatal	Postpartum		
Beck and Indman (2005), US	Cross-sectional	133 postpartum women with depression	The Postpartum Depression Screening Scale (PDSS)		16 weeks	Scores on all seven dimensions of the PDSS were elevated. Dimension of emotional lability had the highest mean score among the 7 dimensions.	W
Bowen A. et al. (2012), Canada	Prospective cohort	45 pregnant women 31 women in control group	VAS, EPDS	16 and 30 weeks	4 weeks	Perinatal women showed higher mean levels of irritable, anxious, and high MI than the non-perinatal women. The findings still held when pregnant women with depressive symptom were excluded from the study.	M

*Quality rating scores are abbreviated. “S” reflects a strong rating, “M” reflects a moderate rating and “W” reflects a weak rating.

Table 2-B.1: Characteristics of included studies (n = 7) continues

Author (year), Country	Study design	Sample size	Measures	Time points		Major findings	Quality rating*
				Antenatal	Postpartum		
Hapgood, Elkind, and Wright (1988), New Zealand	Prospective cohort	66 postpartum women	VAS, the Goldberg semi-structured psychiatric interview		0-2, 6, 13, 26, and 60 weeks	Emotional lability was the important affective component of the early postpartum. Lability of mood in the early postpartum was related to psychiatric symptoms up to 14 months postpartum and was the strongest predictor of later psychopathology.	M
Lotzin et al. (2016), Germany	Cross-sectional	68 postpartum women 68 infants	The Difficulties in Emotion Regulation Scale, the Still-Face paradigm		24 weeks	Higher maternal emotion dysregulation was significantly associated with higher facial affect synchrony; the relationship between the effect of maternal psychopathology and facial affect synchrony was fully mediated by emotion dysregulation.	S

*Quality rating scores are abbreviated. “S” reflects a strong rating, “M” reflects a moderate rating and “W” reflects a weak rating.

Table 2-B.1 Characteristics of included studies (n = 7) continued

Author (year), Country	Study design	Sample size	Measures	Time points		Major findings	Quality rating*
				Antenatal	Postpartum		
Ong et al. (2014), Singapore	Qualitative, exploratory study	13 postpartum women	In-depth interviews, EPDS		7-11 days	Five themes were identified: 1) negative emotion including labile emotions, 2) breastfeeding concerns, 3) social support, 4) cultural postnatal practice, and 5) professional support needs.	S
Tseng et al. (2008), Taiwan	Qualitative, exploratory study	12 pregnant women with depression	Semi - structured interview	2nd or 3rd trimester		Five themes emerged: 1) multiple conflicting roles, 2) lack of social support, 3) dissatisfaction with body image, 4) future uncertainty, and 5) emotional instability.	S
Wilkinson (1999), Australia	Prospective cohort	86 pregnant women 86 women's partners	The Positive and Negative Affect Scale (PANAS), self-reported mood questionnaires	16, and 31 weeks	10 days, 13 weeks	The immediate postpartum was the peak period of positive affect for both primiparous and multiparous mothers and their male partners and was also the peak period of negative affect and mood lability for primiparous women. There was relatively little change in mood from the second to the third trimester, and in the early postpartum. However, primiparous women showed increased mood lability while multiparous women did not experience the increase.	M

*Quality rating scores are abbreviated. "S" reflects a strong rating, "M" reflects a moderate rating and "W" reflects a weak rating.

Transition Note 1

In Chapter 2, the systematic review identified a significant gap in perinatal MI research. The focus of the study was to review existing peer-reviewed publications in English that were related to perinatal MI, its relation to PPD, and its effects on child outcomes. The literature search was conducted on seven academic health databases from 1985 to July 2017, and seven articles met the inclusion criteria. Two of the selected articles discussed perinatal MI longitudinally, one article examined the effects maternal emotion dysregulation on mother-infant interaction, and the rest of the articles investigated PPD, PPB, and the experience of being pregnant, while perinatal MI was a component of the studies. In addition, of the seven selected articles, only three articles were published within ten years. The remarkable gap of perinatal MI research was not just presented in limited quantity, but also in limited types of studies. The findings indicated that in order to further understand perinatal MI, more research in perinatal MI is needed, for example, determining the etiology of perinatal MI, genetic influences, risk factors for perinatal women, longitudinal association between antenatal MI and postpartum psychopathologies, and the effects of perinatal MI on mothers, neonatal, and child outcomes. Therefore, in Chapter 3, a second manuscript is presented to explore the risk factors for perinatal MI at early and late pregnancy, and postpartum, the association between antenatal MI and PPD, and the trajectory of MI in pregnant and postpartum women.

Chapter 3: Manuscript Two

Mood instability across the perinatal period: A cross-sectional and longitudinal study

Abstract

Objective: The purpose of this study was to understand the relationship between perinatal MI and its risk factors at distinct points, between antenatal MI and postpartum depression (PPD), and the trajectory of MI in perinatal women across the perinatal continuum. **Method**: a total of 648 women participated in a longitudinal study of maternal depression at three points: early pregnancy (T1, 17.4 ± 4.9 weeks), late pregnancy (T2, 30.6 ± 2.7 weeks), and postpartum (T3, 4.2 ± 2.1 weeks). Mood instability, depression, stress, and social support were measured at T1, T2, and T3, other sociodemographic data were collected at T1, and obstetrical information was obtained at appropriate times. Multi-linear regression was used to examine MI and its risk factors cross-sectionally, hierarchical multiple regression was utilized to investigate longitudinal relationship between antenatal MI and postpartum depression, and a linear mixed model (LMM) was employed to examine the trajectory of perinatal MI over three periods (T1-T3). **Results**: In the cross-sectional study, MI was significantly associated with perinatal depression, history of depression, and stress at T1, T2, and T3, and with labour/birth complications at T3. Perinatal depression exerts the most effect on MI among the risk factors. Mood instability at T1 was significantly associated with PPD after controlling depression at T1. The trajectory of perinatal MI had a decreased trend overall with a significant declining from T2 to T3. **Conclusion**: The study expands our understanding of MI in perinatal women, which can impact the mental and physical health of their children.

Keywords: Perinatal women; mood instability; risk factors; the trajectory of perinatal mood instability

3.1 Introduction

Mood instability is sometimes used interchangeably with mood dysregulation, affective instability, affective lability, affective and emotional dysregulation, and mood swings (Marwaha, Broome, Bebbington, Kuipers, & Freeman, 2014; Teicher, Ohashi, Lowen, Polcari, & Fitzmaurice, 2015). A useful definition is "extreme and frequent fluctuations of mood over time" (Trull et al., 2008), but time is not well defined and neither are the terms "extreme" or "frequent".

Women's reproductive years, spanning pubescence, pregnancy, postpartum, and menopause, are often associated with increased moodiness (Bowen, A., Bowen, Balbuena, & Muhajarine, 2012; Mitchell, 2017; Toffol, Heikinheimo, & Partonen, 2015). These seemly "harmless" mood switches are often regarded as a normal part of a woman's life by hormonal changes (Buttner, O'Hara, & Watson, 2012; Cunningham et al., 2010; Fooladi, 2006).

Giving birth to a child is most often a joyful event, but it can also be overwhelming and challenging. During pregnancy and delivery, expectant and new mothers undergo not only many physical changes, but also make remarkable emotional, behavioural, cognitive adjustments to adapt to the demands of motherhood (Buist et al., 2008; Goyal, Gay, & Lee, 2007). In addition, the transition to motherhood represents a time of greater vulnerability for women to develop mood-related disturbances, including perinatal depression (Kessler et al., 2003; Milgrom & Gemmill, 2014), and postpartum blues and mood swings (Pop et al., 2015). Studies have found that perinatal women often experience the highest irritable, euphoric, and depressed moods in early pregnancy and again around the time of giving birth (Cunningham et al., 2010; Steiner, Dunn, & Born, 2003). This phenomenon is thought to be triggered by the large hormonal changes that occur at these times (Buttner et al., 2012; Cunningham et al., 2010; Fooladi, 2006).

In a longitudinal study, Bowen, A. et al. (2012) investigated MI in perinatal women. A subgroup of 45 perinatal women participated in this study from the Feelings in Pregnancy and Motherhood Study (FIP) (Bowen, A., Bowen, Butt, Rahman, & Muhajarine, 2012). Co-currently, a control group comprised of normally menstruating non-perinatal women without depressive symptoms (n = 31) from a separate study of moods was also recruited (Bowen, R, Mahmood, Milani, & Baetz, 2011). The perinatal women's mood was assessed at early pregnancy (mean gestation 16.4 weeks, SD 4.4), late pregnancy (mean gestation 30.4 weeks, SD 2.3), and postpartum (mean 4.3 weeks postpartum, SD 1.5). Mood instability was measured by using mood diaries with visual analogue scales (VAS) for depressed, irritable, anxious, and euphoric moods for both groups in the morning and evening. Depression symptoms were assessed by using the Edinburgh Postnatal Depression Scale (EPDS) (Cox, Holden, & Sagovsky, 1987). The perinatal women completed three separate mood diaries (each for 7 days) after three interviews, while the control group completed the mood diaries for two consecutive menstrual cycles (eight weeks). The findings suggested that perinatal women were more likely to experience depressed, irritable, anxious, and euphoric mood fluctuation compared to the controls, indicating perinatal women were moodier. Contrary to most of the existing literature which predominantly focused on depressive mood in the perinatal period, the authors suggested that mood variation is a prominent feature in perinatal women.

Perinatal mood research has focused mostly on depression as diagnostic concepts with duration of a week or more, rather than on MI which usually implies mood fluctuations within a day. This may be due partly to the perception of MI as a normal part of a woman's life, and partly to the tendency for research to focus on diagnostic entities. However, MI research in the general population and clinical samples has indicated that MI is a tans-diagnostic concept, and

associated with a variety of psychiatric disorders and acknowledged by 13.9% of population (Marwaha, Parsons, Flanagan, & Broome, 2013). Several of the major risk factors for perinatal depression are psychosocial and behavioural in nature (e.g., social support, stress, smoking), and emerging literature has suggested that the same factors may also be important in general population with MI (Marwaha et al., 2013). In the longitudinal relationship studies, Marwaha et al. (2015) found that MI predicts depression inception after 18 months in a population study, while Thompson, Berenbaum, and Bredemeier (2011) also found a significant association between MI and major depressive disorder (two months later) after controlling a current major depressive episode in a student sample.

3.2 Research hypothesis

Perinatal MI would be associated with its risk factors at early pregnancy, late pregnancy, and postpartum, antenatal MI would be correlated with postpartum depression (PPD), and perinatal MI would have its distinct trajectory.

3.3 Methods

3.3.1 Participants and procedure

The current study is a secondary data analysis from the Canadian Institute of Health Research Feelings in Pregnancy and Motherhood Study (FIP) (Grant # 145179). The FIP was a longitudinal cohort study of maternal mental health from 2006 to 2014. A total of 648 women were recruited in early pregnancy from a variety of community settings such as doctors' offices, prenatal classes, maternity stores, and responders to radio and newspaper advertisements. The inclusion criteria were English speaking women in early pregnancy (gestation $\leq$ 20 weeks), and a resident in one of two health regions in Saskatchewan (Saskatoon Health Region or Five Hills Health Region). Data collection was conducted by trained research assistants through a face-to-

face interviews at three-time points: T1 early pregnancy (17.4 ± 4.9 weeks), T2 late pregnancy (30.6 ± 2.7 weeks), and T3 postpartum (4.2 ± 2.1 weeks). Information regarding children's birth outcomes was obtained from the mothers and linked with hospital discharge records, with the mother's permission. If a woman screened positive for depression, she was referred with her permission to her family doctor for further investigation and given information about local mental health services; if she was deemed at risk of self-harm or harming others, immediate help was provided. Ethics approval for the research protocol was obtained from the Behavioural Research Ethics Board at the University of Saskatchewan. All participants gave written informed consent.

3.3.2 Measures

Symptoms of depression were measured with the Edinburgh Postnatal Depression Scale (EPDS) (Cox et al., 1987) at T1, T2, and T3. A score of ≥ 12 ($\geq$12 depressed; <12 indicates not depressed) was used in this present study to determine depression status (Smith, Eryigit-Madzwamuse, & Barnes, 2013).

Mood instability was measured by a five item visual analogue scale (VAS): 1 "mood frequent ups and downs", 2 "mood swings occur for no reason", 3 "other people complain about your mood swings", 4 "having trouble following through with plans because of mood swings", and 5 "not making commitments because moods might change". Women were asked to mark an "X" on with a 10cm line. The X was then measured on a metric ruler by a research assistant. This self-reported measure has a total possible score of 50.

Sociodemographic factors

- Age: women's age was calculated based on their birthday at the time of intake. Seventeen women were less than 20 years old, and six women were aged older than 40 years, thus the variable was dichotomized as either <25 years or $\geq$ 25 years old.

- Education attainment: women reported years of education they received from the selections of < 12^{th} grade, = 12th grade, some post-secondary/university, to completed post-secondary/university. The variable was categorized into < grade 12 and ≥ grade 12.
- Marital status: participants were in different relationship arrangements; this variable was categorized as with a partner (married or cohabiting) or without a partner (single, widowed, or divorced).
- Ethnicity: options included Caucasian, Aboriginal with treaty status, non-status Aboriginal, Métis, immigrant, and other. Due to the small number of women who were immigrants or other, the ethnicity of women was dichotomized as Aboriginal or non-Aboriginal.
- Family income: four levels of family income were identified: social assistance or less than $20,000 per year, between $20,000 and $40,000 per year, between $40,000 and $60,000 per year, and greater than $60,000 per year. This variable was categorized as ≤$40,000 or > $40,000.

Psychosocial factors

- History of depression: women were asked "Do you have a history of depression?" The answer was categorized into "yes" based on women's positive answer to the question, and "no" for a negative answer.
- Family history of perinatal depression: women were asked "Did your mother or any of your sisters have depression before or giving birth?" The answer was categorized into "yes" if the answer is positive, and "no" for a negative answer.
- History of abuse: three questions were used to assess history of abuse, "Has anyone ever hit, slap, restrained, punch, pinch, kick, beat you?" "Has anyone ever yell, belittle, berate,

blame, neglect you?" "Has anyone touched you against your will, raped you?" The responses were categorized into a dichotomous variable, "yes" if any type of abuse occurred, and "no" if answers for three questions were no.

- Social support: six questions inquired about the types of support available (emotional support, support of a partner, support of the mother, support of friends, support of female relatives, and other support). The variable was dichotomized as low-level of support (0-1 types support) and high-level of support (two or more types of support).
- Stressors: women were asked to identify their sources of stress including being pregnant, health of baby, birth of baby, own health, relationship with partner, housing, money, and work. The level of stress was categorized into low-stress level (0-2 stressors) or high-stress level ($\geq$ 2 stressors).

Behavioral factors

- Smoking: women were asked, "In the last month, how much do you smoke?" Options included more than a pack/day, 5-20 cigarettes/day, less than five cigarettes a day, quit since pregnant, quit before pregnancy, and never smoked. The variable was categorized into a dichotomized variable, "yes" and "no or quit".
- Alcohol: alcohol use was assessed by asking, "How often did you drink beer or other alcohol?" Potential responses were occasional on a drink or two, 1-2 drinks a day, five or more drinks at one time, quit since pregnant, quit before pregnancy, and never drank alcohol. The variable was summarized into a dichotomized variable, "yes" and "no or quit".
- Drugs: Drug use was determined by asking "How often did you use drugs such as marijuana, crystal meth, and cocaine?" and potential responses included regularly (every day),

occasionally, quit since pregnancy, quit before pregnancy, and never use such drugs. The options were summarized into a dichotomized variable, "yes" and "no or quit".

- Exercise: "In the last month, how much do you exercise?" was used to evaluate women's exercise regimen, and women's answers were every day, 2-3 times per week, occasionally, or never. The responses were categorized into a dichotomous variable with two levels, "regular exercise" and "never or occasionally exercise."

Obstetric outcome factors

- Pregnancy intention: intention was categorized into "yes" based on women's response to "intended pregnancy", and "no" for not intended.
- Parity: the total number of pregnancies, previous abortions and/or miscarriages, and previous preterm and/or full-term deliveries. The variable was summarized into a dichotomous variable, "1" for primigravida and ">1" for multigravida.

3.3.3 Data analyses

A descriptive statistical analysis was conducted to summarize characteristics of participants. At three points, the percentage of depressed women (EPDS ≥12) was calculated. Group specific descriptive statistical analyses were also performed to illustrate MI levels in depressive and non-depressive women, and both MI and depressive levels in women who received antidepressant treatment and who did not take antidepressant at T2 and T3. To measure internal reliability consistency, Cronbach α for EPDS score, and MI score were computed.

3.3.3.1 The association between perinatal mood instability and its risk factors

To investigate the association between perinatal MI and its risk factors, linear regression analysis was used to generate univariate estimate coefficient associated with potential risk factors, and multivariate linear regression analysis was employed to arrive at simple, and robust models at T1, T2, and T3. The dependent variable (DV) MI was measured at T1, T2, and T3.

The independent variables (IVs) including demographic variable at T1, psychosocial and behavioural risk factors at T1, T2, and T3, and obstetric variables were collected at T3 (Appendix A, Table 3-A.1-3).

Model selection for multiple linear regression model. In univariate analysis, the DV was MI. The IVs included depression, marital status, education level, ethnicity, family income, age, history of depression, family history of perinatal depression, history of abuse, stress level, social support, parity, pregnant intention, smoking, alcohol use, drug use, and exercise. For model selection in multivariate linear regression analysis, the backward elimination model building process followed five steps (Montgomery, Peck, & Vining, 2015): 1) keep variables with p-value <0.25 in the univariate analysis; 2) fit the multivariable model containing all covariates identified from inclusion in step 1; 3) in each step of backward selection procedure in step 2, compare the values of the estimated coefficients in the smaller model to their corresponding value from the large model. Any variable whose coefficient has changed substantially in magnitude (e.g., $\Delta\beta$>20%) was put back to refit until all of the important variables are included; 4) put each variable not selected in step 1 to the model obtained at step 3, one at a time, and check its significance by the Wald statistic and *p*-value; 5) put all variables that were significant (*p*-value <0.05) at step 4 in the final model.

3.3.3.2 The association between antenatal mood instability and postpartum depression

To examine the longitudinal relationship between antenatal MI and PPD, hierarchical multiple regression (HMR, one of linear regressions) was used to show if variables of interest explain a statistically significant amount of variance in dependent variable after accounting for all other variables (Petrocelli, 2003). The reason for using HMR in this study is that there is extended longitudinal research on the relationship between antenatal predictors and PPD. For

example, in a synthesis of antenatal risk factors for postpartum depression (PPD) from the meta-analyses of over 24,000 subjects (Robertson, Grace, Wallington, & Stewart, 2004), depression during pregnancy, past history of mental illness, life events, and social support were identified as strong to moderate risk factors for PPD; moderate risk factors include marital relationship and neuroticism; small risk factors included obstetric factors and socioeconomic status. To our knowledge, longitudinal relationship between antenatal MI and PPD has not been studied before. Therefore, we examined whether antenatal MI is still able to predict an outcome when the effects of others variables especially antenatal depression are controlled for. Hierarchical multiple regression has been used in longitudinal studies in a variety of fields; for example, Thompson et al. (2011) investigated the longitudinal relationship between MI and depression in a community sample; antenatal marital relationship and attachment as predictors for postpartum stress, and depression symptoms (Clout & Brown, 2016).

In HMR, IVs are entered into equation in steps specified by the study purpose, each IV is assessed in terms of what it adds to the prediction of DV after the previous IVs have been controlled for, and overall model and relative contribution of each block of variables is assessed (Tabachnick & Fidell, 2007). The DV was depression at T3. The IVs including demographic, psychosocial variables, depression, and MI were assessed at T1 and T2. In the HMR analysis, demographic variables (age, marital status, education, ethnicity, and family income) were entered in step 1, psychosocial variables (history of depression, family history of perinatal depression, stress, history of abuse, exercise, smoking, alcohol use, pregnancy intention, partner support) and depression were entered in step 2, and in step 3, MI was entered. We built three models to investigate the relationship between antenatal variables at T1and PPD in model 1, the relationship between antenatal variables at T2 and PPD in model 2, and finally the relationship

between antenatal variables during pregnancy (T1 + T2) and PPD in model 3. For IVs during pregnancy, MI, as a continuous variable, was averaged ((T1 + T2)/2), and other dichotomous variables including sociodemographic, psychosocial, behavioral, obstetric, and neonatal that were measured at T1 and T2 were added (T1 + T2) (for example, a woman experienced depression during pregnancy, indicating she was depressed at T1 or at T2, or both) (Anand et al., 2005; Dotson, Resnick, & Zonderman, 2008).

3.3.3.3 Trajectory of mood instability

Descriptive data analysis and linear mixed model (LMM) were employed to examine the trajectory of perinatal MI from T1 to T3. Model selection of LMM was followed the steps suggested by Montgomery, Peck and Vining (2015). For each risk variable in the final model, we started with a null model that allowed individual to have a random intercept but a fixed slope. Next, we added risk variable one by one, including time and the interaction term of variable*time (Bueno-López & Bevilacqua, 2013). The Akaike's Information Criterion (AIC) and Bayesian's Information Criterion (BIC) were used to determine the covariance structure and the model (Gregoire & Schabenberger, 1996).

Model selection for linear mixed model. For model selection of LMM, we followed the steps suggested by Montgomery et al. (2015) described above. For fixed effects, risk variables in the final model were entered one at a time, and interaction between each risk factor and time (coded as "1," "2," or "3") into the model. Intercepts were entered as random effect. To identify possible choices for the covariance associated with repeated measures models, covariance structure selection was conducted by utilizing four different covariance structures suggested by West, Welch and Galecki (2014): unstructured, compound symmetry, autoregressive (AR), and Heterogeneous AR. We chose the unstructured covariance structure that obtained the smallest

Akaike's Information Criterion (AIC) and Bayesian's Information Criterion (BIC) (West et al., 2014).

Results were considered to provide evidence of significance if *p*-values <0.05 (α level of 5%). The data were analyzed using SPSS 24 for HMR, and using the SAS 9.3 for the rest of the data analysis.

3.4 Results

3.4.1 Descriptive data analysis and linear regression (simple and multiple) assumption test and model fit diagnostic

Variables of interest for accuracy of skewness, Kurtosis, and outliers were examined. Univariate outliers were detected in some variables (MI and EPDS scores) by using box plot and histogram; however, the outliers were included in the study as they represented clinically relevant cases (such as EPDS score = 30 or 1). The 5% trimmed means were similar to the original means of all variables (Maronna, Martin, & Yohai, 2006). For linear regression model and LMM, MI as continuous variable was skewed, with significant (p <0.001) Kolmogorov-Smirnov and Shapiro-Wilk normality tests, indicating the variable had non-normal distribution. Log-transformation and square root transformation were used to normalize the distribution of the MI score (Singer & Willett, 2003), which did correct skeweness, but Kolmogorov-Smirnov and Shapiro-Wilk normality tests were still significant (p<0.001). Pallant (2007) stated that non-normal distribution of data is typical in social science studies, and violation of normality assumption is not considered to cause biases in data analysis. In this study, log-transformation MI was used because it corrected the skewness. After log-transformation MI was implemented, normality assumption was tested by examining the normality of residuals, the plot of residual versus percent appeared to be mostly normally distributed. The plot of residual versus Quantile

showed a linear trend with a slight deviation at the tail, which suggests that the linearity assumption was satisfied. Multicollinearity diagnostic statistics (tolerance and variance inflation factors (VIF)) were tested, and values of VIF were < 10, indicating that there was no violation of multicollinearity assumption (Brown, Giles, & Greenlund, 2007). The model fit was assessed by examining the plot of standardized residual versus standardized predicted values, which showed that the model fitted the data well (-3, 3) (Montgomery et al., 2015).

For HMR models, normality and linearity assumptions were tested by examining normal probability plot (P-P plot) of the regression standardized residual and the scatter plot. The normal P-P plots showed a linear line with a slight deviation at the mid of the line, which indicated linearity assumption was satisfied. In the scatterplot, the residuals were rectangularly distributed with most of the scores concentrated in the centre, which showed mostly normally distributed. Multicollinearity diagnostic statistics (tolerance and variance inflation factors (VIF)) were tested, and values of VIF were < 10, indicating that there was no violation of multicollinearity assumption (Brown, Giles, & Greenlund, 2007). The model fit was assessed by examining the plot of standardized residual versus standardized predicted values, which showed that the model fitted the data well (-3, 3) (Tabachnick & Fidell, 2007)

Missing data is a common issue in longitudinal studies (Twisk & de Vente, 2002), and the FIP study is no exception. Missing values in this study at all three time points accounted for less than 10%, which is at an acceptable level (Bennett, 2001). At T1, the first 93 women participated in the study before the MI assessment was added to the study; therefore, data was analyzed on 555 women.

The mean age of women was 29.0 years (SD=4.85), and first-time mothers represented 38.3% (n = 248) in this study. The majority of women lived with a partner (90.3%, n = 585),

95% (n = 614) of women had education level of high school diploma or higher, 67.1% (n = 430) of women's family income was equal or greater than $40,000 per year, and Aboriginal women represented 8.5% (n = 55) in this study (Appendix 3-A, Tables 3-A.1-3).

By comparing group mean differences between depressed women and not depressed women, women with depression displayed a significantly higher level of MI than women without depression at T1, T2, and T3 (T1: $t(553) = 15.218$, $p < 0.001$; T2: $t(589) = 13.146$, $p < 0.001$; T3: $t(593) = 12.761$, $p < 0.001$).

Thirteen women (2.0%) reported taking antidepressants at T2, and of those women, 30.8% (n = 4) were depressed (EPDS score ≥ 12); 26 women (4.4%) took antidepressants at T3 (two of them were breastfeeding), and in which 34.6% (n = 9) experienced elevated depressive symptoms (EPDS score ≥ 12). There was no information at T1. By comparing group mean differences in EPDS, women who received antidepressant treatment at T2 and T3 displayed a significantly higher level of depressive symptoms than women without antidepressant treatment (T2: $t(598) = 4.50$, $p < 0.001$; T3: ($t(586) = 4.47$, $p < 0.001$ respectively). However, by comparing group mean differences between depressed women without antidepressant treatment and women with the treatment, depressed women without antidepressant treatment at T2 and T3 reported a significantly higher level of depressive symptoms than women with the treatment (T2: $t(62) = 3.098$, $p = 0.003$; T3: $t(59) = 4.274$, $p < 0.001$). The means and standard deviations are presented in Table 3.1.

In a comparison of group mean differences in MI scores, women who received antidepressant treatment at T2 and T3 displayed significantly elevated scores in MI than women without antidepressant treatment (T2: $t(574) = 3.59$, $p < 0.001$; T3: $t(588) = 5.16$ $p < 0.001$ respectively). When comparing mean MI score differences, there was no significant difference

between depressed women without antidepressant treatment and depressed women with the treatment (T2: t(67) = 0.943, p =0.349; T3: t(57) = 1.262, p = 0.212).

The results of Cronbach α (ranging from 0.824 to 0.870) indicate high internal consistency for both measurements at three-time points (Cronbach, 1951) (Table 3.1).

Table 3.1: Mean scores of EPDS and MI, Cronbach α (n = 555 at T1, n = 603 at T2, and n = 595 at T3)

Measurements	Mean	SD	Depressed (%) (EPDS score ≥ 12)	Cronbach α
EPDS score at T1	6.82	4.42	13.53	0.834
Depressed (EPDS score ≥ 12)	14.85	3.13		
Not depressed (EPDS score < 12)	5.49	3.01		
EPDS score at T2	6.25	4.31	10.61	0.824
Depressed (EPDS score ≥ 12)	15.20	3.47		
Not depressed (EPDS score < 12)	5.18	3.00		
Medication treatment	11.46	7.45	30.80	
Without treatment	6.13	4.19	8.03	
EPDS score at T3	5.64	4.12	7.90	0.830
Depressed (EPDS score ≥ 12)	15.43	3.40		
Not depressed (EPDS score < 12)	4.74	2.91		
Medication treatment	9.08	7.08	34.62	
Without treatment	5.43	3.88	3.38	
MI score at T1	14.63	11.00		0.855
Depressed (EPDS score ≥ 12)	29.22	10.29		
Not depressed (EPDS score < 12)	12.08	9.07		
MI score at T2	14.00	9.42		0.870
Depressed (EPDS score ≥ 12)	27.23	10.24		
Not depressed (EPDS score < 12)	12.43	8.06		
Medication treatment	21.91	9.99		
Without treatment	13.81	9.39		
MI score at T3	12.08	8.24		0.870
Depressed (EPDS score ≥ 12)	24.98	9.90		
Not depressed (EPDS score <12)	10.93	6.96		
Medication treatment	18.35	11.00		
Without treatment	11.80	8.00		

*Note: information on medication treatment was not available at T1

3.4.2 The association between perinatal mood instability and its risk factors

A majority of risk factor variables showed statistically significant association with MI in univariate linear regression (Appendix 3-A, Tables 3-A.1-3). The multivariate linear regression

results revealed that depression, history of depression, and stress at T1, T2, and T3 were significant risk factors for MI1, MI2, and MI3 respectively, and additionally, labour/birth complication was a significant risk factor for MI at T3. The overall models at T1, T2, and T3 are statistically significant (p <0.0001). These parameter estimates correspond to the estimate coefficients presents in Table 3.2, and represent the statistically significant effects of each independent variable, holding all other variables constant. Although we found a strong univariate association between MI and age, ethnicity, family income, family history of perinatal depression, history of any abuse, exercise, smoking, alcohol use, social support, parity, and breastfeeding, these were not established as independently operating risk factors in multivariate linear regression analysis.

Table 3.2: Association between mood instability and its risk factors - cross-sectional multivariate linear regression results (n = 555 at T1, n = 603 at T2, and n = 595 at T3)

Risk factor	Estimate coefficient (95%CIs)	*P*-value
	T1	
Antenatal depression (EPDS ≥12) at T1	0.307 (0.242 - 0.372)	<0.0001
History of depression	0.131 (0.073 - 0.189)	0.0002
Stress at T1	0.116 (0.053 - 0.180)	0.0004
	T2	
Antenatal depression (EPDS ≥12) at T2	0.306 (0.253 – 0.340)	<0.0001
History of depression	0.098 (0.054 – 0.141)	<0.0001
Stress at T2	0.088 (0.036 – 0.140)	0.0010
	T3	
Postpartum depression (EPDS ≥12) at T3	0.297 (0.239 - 0.354)	<0.0001
History of depression	0.067 (0.026 - 0.107)	0.0010
Stress at T3	0.122 (0.059 - 0.186)	0.0002
Labour/birth complications	0.044 (0.005 – 0.082)	0.0270

3.4.3 The association between antenatal mood instability and postpartum depression

Hierarchy multiple regression (HMR) model 1 examined the association between independent variables, including demographic variables, psychosocial variables, depression, and MI at T1 and PPD at T3. In the first step of HMR, demographic variables of age, marital status, education attainment, ethnicity, and income were entered. This model was not statistically significant (F (5, 481) = 1.550; $p = 0.173$), and explained 1.6% of variance in PPD. In the second step of HMR, psychosocial variables and depression were entered into the equation. The total variance explained by the model was 14.5% (F (12, 474) = 6.704; $p < 0.001$), and the model was statistically significant. After entry of MI at T1 at step 3 the total variance explained by the model as a whole was 15.3% (F (13, 473) = 6.567; $p < 0.001$). The introduction of MI explained additional 0.80% of variance in PPD at T3, after controlling for demographic and psychosocial variables and depression (R^2 change = 0.008; F (1, 473) = 4.349; $p = 0.038$). In the final adjusted model, three variables (stress, depression, and MI) were statistically significant ($\beta = 0.109$, $p = 0.024$; $\beta = 0.231$, $p < 0.001$; $\beta = 0.115$, $p = 0.038$ respectively) (Appendix 3-B, Table 3-B.1).

Hierarchy multiple regression (HMR) model 2 investigated the relationship between independent variables including demographic variables, psychosocial variables, depression, and MI at T2 and PPD at T3. In the first step of HMR, demographic variables of age, marital status, education attainment, ethnicity, and income. This model was not statistically significant (F (5, 454) = 1.102; $p = 0.358$), and explained 1.2% of variance in depression (PPD). In the second step of HMR, psychosocial variables and depression were entered into the equation. The total variance explained by the model was 20.8% (F (13, 446) = 8.996; $p < 0.0001$), and the model was statistically significant. After entry of MI at T2 at step 3, the total variance explained by the model as a whole was 21.0% (F (14, 445) = 8.454; $p < 0.001$). The introduction of MI explained

additional 0.2% of variance in PPD at T3, after controlling for demographic and psychosocial variables and depression (R^2 change = 0.002; F (1, 445 = 1.325; p = 0.250). In the final adjusted model, two variables (stress and depression) were statistically significant (β = 0.176, $p < 0.001$; β = 0.310, $p < 0.001$ respectively) (Appendix 3-B, Table 3-B.2).

Hierarchy multiple regression (HMR) model 3 explored the relationship between IVs, including demographic variables, psychosocial variables, depression, and MI during pregnancy (T1+T2) and PPD at T3. Similarly, in the first step of HMR, demographic variables of age, marital status, education attainment, ethnicity, and income. This model was not statistically significant (F (5, 456) = 1.288; p = 0.268), and explained 1.4% of variance in depression (PPD). In the second step of HMR, psychosocial variables and depression were entered into the equation. The total variance explained by the model was 22.1% (F (12, 449) = 10.644; $p <$ 0.001), and the model was significant. The introduction of MI explained additional 0.2% of variance in PPD at T3, after controlling for demographic and psychosocial variables and depression (R^2 change = 0.002; F (1, 448) = 1.111; p = 0.292). In the final adjusted model, two variables (stress and depression) were statistically significant (β = 0.147, p =0.002; β = 0.332, p < 0.001 respectively) (Appendix 3-B, Table 3-B.3).

3.4.4 Trajectory of perinatal mood instability

Mood instability mean scores displayed a declined course from T1 (mean = 14.63, *SD* = 11.0), T2 (mean = 14.00, *SD* = 9.42) to T3 (mean = 12.08, *SD* = 8.24). However, the declining of MI level from T2 to T3 was statistically significant (t(591) = 4.32, $p < 0.001$). Similarly, on the EPDS, 13.5% of women (n = 92) scored ≥ 12 at T1, 10.6% (n = 64) at T2, and 7.9% (n = 47) at T3, which showed a decreased trend from T1 to T2, and to T3 (Table 3.1).

For the trajectory of the relationship between MI and depression from T1 to T3, we selected IVs that were fitted by LMM based on their level of significance (p-value <0.05). For fixed effects, time and risk factors were entered one at a time, including time, depression (EPDS), stress level, history of depression, and interaction between each risk factor and time (coded as "1," "2," or "3") into the model. Random intercept over time was added to the model to account for the correlation of repeated measures on the same individual, so that each individual has its own regression equation allowing for evaluating whether individuals differ in their means or response patterns over time. We chose the unstructured covariance structure with the smallest Akaike's Information Criterion (AIC) and Bayesian's Information Criterion (BIC) (Gregoire & Schabenberger, 1996). The best model selected was without interaction terms based on the smallest AIC and BIC (Appendix 3-C Table 3-C.1). Mood instability was significantly elevated in women with depression (EPDS ≥ 12), a higher level of stress, and history of depression from T1 to T3 (Table 3.3). A test of depression-by-time, stress-by-time, and history of depression-by-time interaction terms was not significant, indicating that there were no significant differences in the changes from T1 to T3 of MI values for both groups of depressed versus non-depressed, more stressed versus less stressed, and having a history of depression versus no history of depression.

Table 3.3: Trajectory of mood instability in women with depression vs. without depression, with history of depression vs. without history of depression, and with more stress vs. with less stress - estimated regression coefficients and their estimated standard errors from linear mixed model (n=555)

Term	Estimate coefficient	Standard Error	P-value
Fixed effects			
Intercept	1.412	0.024	<0.0001
Time (T1 vs. T2)	0.022	0.014	0.088
Time (T2 vs. T3)	0.052	0.012	<0.0001
Depression	0.305	0.021	<0.0001
More stress	0.079	0.013	<0.0001
History of depression	0.118	0.019	<0.0001
Random effects			
Intercept	0.027	0.002	<0.0001
Residuals	0.042	0.002	<0.0001

3.5 Discussion

This is the first study of investigating the relationship between perinatal MI and its relation to PPD and risk factors cross-sectionally and longitudinally. We were able to replicate the significant association between depression and MI reported in the general and clinical populations cross-sectionally (Berenbaum, Bredemeier, Boden, Thompson, & Milanak, 2011; Bowen, R., Wang, Balbuena, Houmphan, & Baetz, 2013). Notably, this relationship had persisted throughout the perinatal period at each time point. Prospectively, we found that MI at 17 weeks of pregnancy was significantly associated with depression at 4 weeks of postpartum, while controlling depression at 17 weeks of pregnancy, suggesting MI during early pregnancy is an independent risk factor for subsequent PPD. Mood instability at 31 weeks of pregnancy and during pregnancy was not associated with PPD, which may be due to the fact that depressive symptoms at 31 weeks of pregnancy played a larger role in predicting depressive symptoms at postpartum (after adding depression into the model, R^2 changed 19.6% of variance explained by

the model, while after adding MI into the model, R^2 changed 3.5% of variance explained by the model).

To understand the relationship between MI and depression, the literature proposes that affective instability and depression share several associations (Thompson et al., 2011). MI is a core feature of neuroticism which in turn is a risk factor for depression (Bowen, R., Balbuena, Leuschen, & Baetz, 2012). Individual differences in neuroticism and negative emotionality have been indicated as a central factor in explaining comorbidity among psychiatric symptoms (e.g., depression, MI) (Beatson & Rao, 2013; Bowen, R et al., 2011; Denollet & De Vries, 2006; Miller, D., Vachon, & Lynam, 2009; Miller, J. & Pilkonis, 2006; Quilty, Sellbom, Tackett, & Bagby, 2009). A meta-analysis of 175 studies reported a strong association between neuroticism and depression (Kotov, Gamez, Schmidt, & Watson, 2010). Stress has been identified as another shared association of depression and MI. As extreme shifts in mood that last from a few hours to a few days, MI may be a result of interpersonal stress, and high levels of MI may also lead to stressful life events (e.g., the break-up of a relationship, loss of a job) (Koenigsberg et al., 2002). A significant correlation between depression and stress has been documented in both general and perinatal population (Fried, Nesse, Guille, & Sen, 2015; Reid & Taylor, 2015).

To examine the significant difference in MI between women with a history of depression and without a history of depression, we tested whether the relationship was due to the effect of including women who were currently depressed (Thompson et al., 2011). Even after excluding women with current depression, women with history of depression were experiencing a significantly higher level of MI than women without at T1 ($t(273) = 2.24$, $p = 0.026$), and at T3 ($t(229) = 2.61$, $p = 0.010$), but non-significant result at T2 ($t(452) = 1.934$, $p = 0.054$), which

may suggest that the positive relationship between MI and history of depression is not driven by current depressive symptoms during 17 weeks pregnancy and 4 weeks postpartum.

Stress was identified as an independent risk factor for MI cross-sectionally, which is similar to other studies on MI in the non-perinatal women (Ebner-Priemer et al., 2007; Marwaha, Parsons, & Broome, 2013). Stress was also associated with PPD in the current study, which is in agreement with previous studies (Glover, 2014; Reid & Taylor, 2015). The transition to motherhood is often considered to be stressful, which can be related to many factors, such as physiological changes, pregnancy and delivery-related stress, role adjustment, and lack of social support that could make perinatal women uniquely vulnerable to develop mood symptoms (Bottino, Nadanovsky, Moraes, Reichenheim, & Lobato, 2012; Misri et al., 2010). As addressed earlier, stress was one factor associated in the relationship between MI and depression. The current study confirmed the similar association between stress, depression, and MI in the perinatal population, suggesting that pregnancy and postpartum-related stress are not only associated with perinatal depression, but also with perinatal MI.

Among postpartum related risk factors, labour/birth complications exert a statistically significant effect on MI. Notably, the relationship between labour/birth complications and MI was prospective since MI was assessed at 4 weeks after giving birth, indicating that labour/birth complications may be an independent risk factor for MI after 4 weeks postpartum.

In addition, significant relationships between antenatal depression and PPD, and between antenatal stress and PPD were confirmed in the current study which is in agreement with other studies. Previous studies suggest that the best predictor for PPD is antenatal depression (O'Hara & McCabe, 2013; Pope, S. & Pope, 2000; Robertson et al., 2004; Steiner, 1998, 2002). Antenatal

stress has been correlated with an increased risk of PPD (Chojenta, Loxton, & Lucke, 2012; Demirchyan, Petrosyan, & Armenian, 2014; Rogers, Kidokoro, Wallendorf, & Inder, 2013).

Although most women who experience depressive symptoms prefer non-pharmacological intervention during pregnancy and postpartum, antidepressant medication remains the most common treatment (Pearlstein et al., 2006). The effectiveness of antidepressant medications in treating perinatal depression is understudied (Vu & Shaya, 2017). To test whether antidepressant medication would improve perinatal depressive symptoms, we examined the depressive levels in depressed women (EPDS score $\geq$ 12) without antidepressant treatment and women with the treatment. We found that depressed women (EPDS score $\geq$ 12) without antidepressant treatment experienced a significantly higher level of depressive symptoms than women who received antidepressant treatment (T2: $t(62) = 3.098$, $p = 0.003$; T3: $t(59) = 4.274$, $p < 0.001$), suggesting that women who are depressed during the perinatal period may benefit from antidepressant treatment. However, we had an opposite result; there was no significant difference of mean MI scores between depressed women without antidepressant treatment and women with the treatment, indicating that antidepressants may not be effective in treating perinatal MI. The findings must be interpreted with caution because only 13 women received antidepressant treatment at T2, and the following factors were not taken into consideration: severity of depressive symptoms, level of women's compliance with antidepressant treatment, and whether women received counseling during this period.

The current study investigated the trajectory of MI from 17 weeks and 31 weeks pregnancy to 4 weeks of postpartum, and found that perinatal women had the highest level of MI at 17 weeks of pregnancy, a slightly lower level at 31 weeks of pregnancy, and a 13.71% decrease from late pregnancy to postpartum (Table 3.1). The declining of MI level from T2 to T3

was statistically significant ($t(591) = 4.32$, $p < 0.001$). The findings demonstrate that the distribution of total scores of MI differed before and after childbirth, but was not significantly different from 17 weeks of pregnancy to 31 weeks of pregnancy, suggesting that pregnant women are more likely to experience elevated MI symptoms than postpartum women.

Notably, although overall trajectory of depressive symptoms had declined from 17 weeks and 31 weeks of pregnancy to 4 weeks postpartum for entire sample (EPDS score: 6.82 at T1, 6.25 at T2, and 5.64 at T3), depressive level among depressed women (EPDS ≥12) had remained almost at the same level with slightly increasing trend from T1 to T3 (EPDS score: 14.85 at T1, 15.20 at T2, and 15.43 at T3). However, MI level in depressed women had declined from T1 to T3 (6.8% declining from T1 to T2, and 8.3% of declining from T2 to T3), indicating MI has its own trajectory among depressed women during the perinatal period.

3.6 Implications

The findings from the current study have several implications. First, the significant relationship between MI and depression cross-sectionally and longitudinally indicates the importance of early detection and early intervention of perinatal MI. Screening for MI should be included in routine perinatal care in primary settings. Second, the identification of risk factors that precede and are associated with perinatal MI, and identification of antenatal MI as a risk factor for PPD would offer another possible opportunity for early detection and early intervention. For example, stress can be alleviated by utilizing coping strategies such as exercise and meditation (Bowen, R, Balbuena, Baetz, & Schwartz, 2013; Cairney, Kwan, Veldhuizen, & Faulkner, 2014). Third, given normalization of MI during perinatal period, increasing awareness of perinatal MI among the health care providers and the general public is essential in terms of early detection and intervention.

3.7 Limitations

There are several limitations in the study. First, participants were predominantly Caucasian, married, with post-secondary education, and higher family incomes, which limits the generalization of the findings. Second, self-reported risk behaviours such as smoking, alcohol consumption, and drug use are often under-reported, particularly during the perinatal period because of social desirability bias (Alvik, Haldorsen, & Lindemann, 2005; Van de Mortel, 2008). Third, the measure of MI and depression relied on participants' subjective report and retrospective recall of symptoms. Retrospective recall can cause bias in different ways, such as it can be influenced by cognitive processes used to reconstruct past events (Schwartz & Rapkin, 2004). Fourth, there is limited literature on MI, especially on perinatal women.

3.8 Conclusion

The current study indicates that perinatal MI as a phenomenon is not a simple "part of the normal reproductive process," rather MI is a serious mental health condition. The study expands our understanding of MI in perinatal women, which is important because perinatal MI has a potential negative impact on mental and physical health of perinatal women, and consequently, their children. In order to improve maternal mental health and the quality of life among perinatal women who experience MI, and the health of their children, MI assessment should be included in routine perinatal care. More research on MI, particularly perinatal MI is needed.

3.9 References

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3.10 Appendix 3-A: Tables of summary of the association between MI and risk factors

Table 3-A.1: Summary of the association between MI and risk factors at T1 (N = 555)

Risk factor (N)	Frequency (%)	Estimate Coefficient (95% CIs)	*P*-value
Marital status (555)		0.253 (0.152 - 0.355)	<.0001
Without partner	45 (8.1)		
With partner	510 (91.9)		
Education (554)		0.137 (-0.010 - 0.285)	0.068
< high school diploma	24 (4.2)		
≥ high school diploma	530 (95.8)		
Ethnicity (545)		0.232 (0.121- 0.342)	<.0001
Aboriginal	39 (7.2)		
Non-Aboriginal	506 (92.8)		
Family income (529)		0.055 (-0. 011 - 0.120)	0.100
≤$40,000	158 (29.9)		
>$40,000	371 (70.1)		
Age (555)		0.032 (-0.008 – 0.117)	0.087
<25	90 (16.2)		
≥ 25	465 (83.8)		
Depression (544)		0.398 (0. 336 - 0.458)	<.0001
EPDS ≥12	73 (13.5)		
EPDS <12	471 (87.5)		
Personal history of depression (545)		0.264 (0. 205 – 0. 322)	<.0001
Yes	189 (35.0)		
No	354 (65.0)		
Family history of perinatal depression (545)		0.148 (0. 082 – 5.201)	<.0001
Yes	142 (26.1)		
No	403 (73.9)		
History of abuse (physical or emotional or sexual) (545)		0.040 (0.022 – 0.178)	0.012
Yes	306 (56.1)		
No	239 (43.9)		
Stress level (549)		0.213 (0.243 - 0.325)	<0.0001
More (>2)	224 (40.8)		
Less (0-2)	325 (59.2)		
Social support (544)		0.023 (-0.048 - 0.002)	.0.067
Less (0-1)	67 (12.7)		
More (≥2)	475 (87.3)		

Table 3-A.1: Summary of the association between MI and risk factors at T1 (N = 555) continues

Risk factor (N)	Frequency (%)	Estimate Coefficient (95% CIs)	*P*-value
Parity at intake (553)		0.103 (0.-13 – 0.136)	0.017
Multigravida	342 (61.9)		
Primigravida	211 (38.1)		
Pregnancy intention (541)		0.115 (0.043 - 0.188)	0.002
No	117 (21.6)		
Yes	424 (78.4)		
Smoking (553)		0.141 (0.061 – 0.243)	0.001
Yes	60 (10.9)		
No or quit	493 (89.1)		
Alcohol use (547)		0.202 (0.153 – 0.368)	<0.0001
Yes	38 (6.9)		
No or quit	509 (93.1)		
Drug use (545)		0.031 (-0.111 – 0.242)	0.467
Yes	16 (2.9)		
No or quit	529 (97.1)		
Exercise (553)		0.154 (0.050 – 0.169)	<0.0001
Never or occasional	255 (46.1)		
Regular	298 (53.9)		

Table 3-A.2: Summary of the association between MI and risk factors at T2 (N = 603)

Risk factor (N)	Frequency (%)	Estimate Coefficient (95% CIs)	*P*-value
Marital status (603)		0.126 (0.046 -0.207)	0.020
Without partner	49 (8.1)		
With partner	554 (91.9)		
Education (603)		0.084 (-0.386 - 0.207)	0.176
< high school diploma	26 (4.2)		
≥ high school diploma	577 (95.8)		
Ethnicity (603)		0. 174 (0.84 - 0.264)	<0.001
Aboriginal	44 (7.2)		
Non-Aboriginal	559 (92.8)		
Family income (603)		0. 015 (-0. 044 - 0.075)	0.616
≤$40,000	180 (29.9)		
>$40,000	423 (70.1)		
Age (603)		0.025 (-0.035 – 0.062)	0.582
<25	96 (15.9)		
≥ 25	507 (84.1)		
Depression (602)		0.422 (0.341 - 0.503)	<.0001
EPDS ≥12	64 (10.6)		
EPDS <12	538 (89.4)		
Personal history of depression (603)		0. 161 (0.113 - 0 208)	<.0001
Yes	211 (35.0)		
No	392 (65.0)		
Family history of perinatal depression (603)		0. 106 (0.053- 0.158)	<.0001
Yes	158 (26.1)		
No	445 (73.9)		
History of abuse (physical or emotional or sexual) (603)		0.019 (-0.032 – 0.059)	0.546
Yes	338 (56.1)		
No	265 (43.9)		
Stress level (598)		0.198 (0.134 – 0.216)	<0.0001
More (>2)	257 (43.0)		
Less (0-2)	341 (57.0)		
Social support (603)		0.002 (-0.006- 0.001)	0.572
Less (0-1)	77 (12.7)		
More (≥2)	526 (87.3)		

Table 3-A.2: Summary of the association between MI and risk factors at T2 (N = 603) continues

Risk factor (N)	Frequency (%)	Estimate Coefficient (95% CIs)	*P*-value
Parity at intake (603)		0.063 (-0.014 – 0.088)	0.154
Multigravida	373 (61.9)		
Primigravida	230 (38.1)		
Pregnancy intention (603)		0. 089 (0.031 - 0.147)	0. 003
No	130 (21.6)		
Yes	473 (78.4)		
Smoking (602)		0.063 (-0022 – 0.137)	0.157
Yes	62 (10.3)		
No or quit	540 (89.7)		
Alcohol use (602)		0.055 (-0.052 – 0.230)	0.219
Yes	36 (6.0)		
No or quit	566 (94.0)		
Drug use (602)		0.013 (-0.214 – 0.286)	0.775
Yes	8 (0.7)		
No or quit	598 (99.3)		
Exercise (602)		0.091 (0.022 – 0.101)	0.002
Never or occasional	262 (43.5)		
Regular	340 (56.5)		

Table 3-A.3: Summary of the association between MI and risk factors at T3 (N = 595)

Risk factor (N)	Frequency (%)	Estimate Coefficient (95% CIs)	*P*-value
Marital status (595)		0.003 (-0.074 -0.079)	0.949
Without partner	45 (8.1)		
With partner	510 (91.9)		
Education (595)		0.066 (-0.057 - 0.188)	0.291
< high school diploma	24 (4.2)		
≥ high school diploma	530 (95.8)		
Ethnicity (595)		0.054 (-0.034 - 0.142)	0.231
Aboriginal	39 (7.2)		
Non-Aboriginal	506 (92.8)		
Family income (595)		0. 015 (-0.045- 0.075)	0. 616
≤$40,000	158 (29.9)		
>$40,000	371 (70.1)		
Age (595)		0.025 (-0.035 – 0.062)	0.582
<25	19 (3.2)		
≥25	323 (58.3)		
Depression (591)		0.398 (0. 336 - 0.459)	<.0001
EPDS ≥12	47 (7.9)		
EPDS <12	544 (92.1)		
Personal history of depression (595)		0.264 (0. 205 – 0.322)	<.0001
Yes	189 (35.0)		
No	354 (65.0)		
Family history of perinatal depression (595)		0.148 (0. 082 - 0.214)	<.0001
Yes	142 (26.1)		
No	403 (73.9)		
History of abuse (physical or emotional or sexual) (595)		0.030 (0.010 – 0.050)	0.004
Yes	306 (56.1)		
No	239 (43.9)		
Stress level (593)		0.251 (0.213 – 0.3.645)	<0.001
More (>2)	256 (43.0)		
Less (0-2)	340 (57.0)		
Social support (591)		0. 228 (0. 149 - 0.307)	<.0001
Less (0-1)	67 (12.7)		
More (≥2)	475 (87.3)		

Table 3-A.3: Summary of the association between MI and risk factors at T3 (N = 595) continues

Risk factor (N)	Frequency (%)	Estimate Coefficient (95% CIs)	*P*-value
Parity at intake (595)		0.026 (-0.033 – 0.061)	0.562
Multigravida	342 (61.9)		
Primigravida	211 (38.1)		
Pregnancy intention (595)		0.010 (-0.045 - 0.064)	0.730
No	117 (21.6)		
Yes	424 (78.4)		
Smoking (594)		0.032 (-0.048 – 0.104)	0.473
Yes	60 (10.1)		
Never or quit	534 (89.9)		
Alcohol use (591)		0.109 (0.021 – 0.199)	0.016
Yes	212 (35.9)		
Never or quit	379 (64.1)		
Drug use (594)		0.038 (-0.055 - 0.131)	0.424
Yes	8 (3.3)		
No or quit	586 (96.7)		
Exercise (594)		0.089 (0.001 – 0.091)	0.047
Never or occasional	262 (43.5)		
Regular	340 (56.5)		
Labour/birth complications (566)		0.051 (0.007- 0.097)	0.024
Yes	322		
No	214		
Neonatal complication (567)		0.049 (0.005 - 0.947)	0.031
Yes	328		
No	239		
Breastfeeding (566)		0.051 (-0.011 - 0.114)	0.108
No	416		
Yes	150		

3.11 Appendix 3-B: Tables of hierarchical multiple regression models

Table 3-B.1: Association between antenatal MI at T1 and PPD-Hierarchical multiple regression model1

	R	**R^2**	**R^2 change**	**β**	**SE**	**T**
Step 1	0.126	0.016				
Age				0.008	0.344	0.182
Marital status				0.077	0.683	1.578
Education attainment				-0.005	0.433	-0.098
Ethnicity				0.037	0.729	0.781
Income				0.113*	0.412	2.417
Step 2	0.381	0.145***	0.129			
Age				0.028	0.337	0.611
Marital status				0.064	0.734	1.233
Education attainment				0.022	0.425	0.492
Ethnicity				0.006	0.721	0.138
Income				0.042	0.426	0.871
History of depression				0.032	0.411	0.721
Exercise				0.009	0.357	0.216
Alcohol use				0.022	0.690	0.498
Smoking				0.007	0.584	0.150
Stress				0.114*	0.224	2.351
Social support				0.010	0.546	0.214
Depression (EPDS)				0.294***	0.047	5.804
Step 3	0.391	0.153*	0.008			
Age				0.024	0.333	0.525
Marital status				0.065	0.724	1.259
Education attainment				0.008	0.420	0.442
Ethnicity				0.009	0.713	0.200
Income				0.043	0.421	0.904
History of depression				0.027	0.406	0.598
Exercise				0.003	0.355	0.067
Alcohol use				0.012	0.730	0.267
Smoking				0.008	0.577	0.176
Stress				0.109*	0.225	2.261
Social support				0.021	0.544	0.454
Depression (EPDS)				0.231***	0.055	3.910
Mood instability				0.115*	0.021	2.085

Note: Statistical significance: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
R^2 = amount of variance explained by IVs
R^2 change – additional variances in DV
β = standardized coefficient
SE = Standard error
t = estimated coefficient divided by its own SE. If $t < 2$ the IV does not belong to the model.

Table 3-B.2: Association between antenatal MI at T2 and PPD-Hierarchical multiple regression model2

	R	**R^2**	**R^2 change**	**β**	**SE**	**T**
Step 1	0.110	0.012				
Age				0.014	0.350	0.294
Marital status				0.045	0.697	0.897
Education attainment				0.012	0.440	0.243
Ethnicity				0.037	0.742	0.768
Income				0.103*	0.451	2.089
Step 2	0.456	0.208***	0.196			
Age				0.009	0.337	0.207
Marital status				0.027	0.757	0.537
Education attainment				0.024	0.425	0.540
Ethnicity				0.007	0.821	0.156
Income				0.032	0.416	0.715
History of depression				0.043	0.398	0.943
Exercise				0.047	0.355	1.099
Alcohol use				0.064	0.952	1.498
Smoking				0.051	0.603	1.150
Stress				0.178***	0.217	3.873
Social support				0.011	0.626	0.336
Depression (EPDS)				0.349***	0.045	7.671
Step 3	0.458	0.210	0.002			
Age				0.011	0.388	0.246
Marital status				0.026	0.744	0.521
Education attainment				0.025	0.418	0.559
Ethnicity				0.006	0.821	0.135
Income				0.027	0.412	0.587
History of depression				0.041	0.399	0.901
Exercise				0.053	0.357	1.236
Alcohol use				0.065	0.986	1.534
Smoking				0.052	0.639	1.167
Stress				0.216***	0.217	3.831
Social support				0.012	0.615	0.259
Depression (EPDS)				0.310***	0.057	5.465
Mood instability				0.064	0.025	1.151

Note: Statistical significance: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
R^2 = amount of variance explained by IVs
R^2 change – additional variances in DV
β = standardized coefficient
SE = Standard error
t = estimated coefficient divided by its own SE. If $t < 2$ the IV does not belong to the model.

Table 3-B.3: Association between antenatal MI at T1 + T2 and PPD-Hierarchical multiple regression Model 3

	R	R^2	R^2 change	β	SE	T
Step 1	0.118	0.014				
Age				0.015`	0.374	0.301
Marital status				0.061	0.754	1.205
Education attainment				0.006	0.438	0.118
Ethnicity				0.035	0.840	0.705
Income				0.108*	0.454	2.242
Step 2	0.471	0.221***	0.208			
Age				0.018	0.332	0.406
Marital status				0.066	0.716	1.361
Education attainment				0.013	0.420	0.298
Ethnicity				0.010	0.764	0.213
Income				0.024	0.421	0.544
History of depression				0.013	0.391	0.282
Exercise				0.007	0.357	0.155
Alcohol use				0.031	0.618	0.729
Smoking				0.010	0.575	0.234
Stress				0.149**	0.242	3.162
Social support				0.005	0.488	0.115
Depression (EPDS)				0.371***	0.054	7.635
Step 3	0.473	0.223	0.002			
Age				0.015	0.340	0.356
Marital status				0.067	0.716	1.386
Education attainment				0.007	0.425	0.156
Ethnicity				0.011	0.764	0.236
Income				0.021	0.422	0.648
History of depression				0.011	0.391	0.247
Exercise				0.001	0.359	0.031
Alcohol use				0.029	0.619	0.644
Smoking				0.011	0.614	0.253
Stress				0.147**	0.242	3.122
Social support				0.003	0.487	0.068
Depression (EPDS)				0.332***	0.068	5.422
Mood instability				0.061	0.028	1.054

Note: Statistical significance: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
R^2 = amount of variance explained by IVs
R^2 change – additional variances in DV
β = standardized coefficient
SE = Standard error
t = estimated coefficient divided by its own SE. If $t < 2$ the IV does not belong to the model.

3.12 Appendix 3-C: Table of covariance structure selection results

Table 3-C.1: Linear mixed model covariance structure selection results

Model	Covariance Structures							
	Unstructured		Compound symmetry		Autoregressive (1)		Heterogeneous AR(1)	
	AIC	BIC	AIC	BIC	AIC	BIC	AIC	BIC
Intercept only	398.7	409.6	398.7	416.0	398.7	416.0	398.7	416.0
Intercept and time	386.8	408.5	388.8	414.8	388.8	414.8	388.8	414.8
Intercept, time, and epds	145.2	171.1	147.2	177.5	147.2	177.5	147.2	177.5
Intercept, time, epds, epds*time	145.3	179.9	147.3	186.2	147.3	186.2	147.3	186.2
Intercept, time, and stress	326.2	352.2	328.2	358.5	328.2	358.5	328.2	358.5
Intercept, time, stress, and stress*time	316.8	351.4	318.8	357.7	318.8	357.7	318.8	357.7
Intercept, time, and history of depression	308.4	334.3	310.4	340.6	310.4	340.6	310.4	340.6
Intercept, time, history of depression, and history of depression*time	290.8	325.4	292.8	331.7	292.8	331.7	292.8	331.7
Intercept, time, epds, and stress	102.0	132.3	104.0	138.6	104.0	138.6	104.0	138.6
Intercept, time, epds, stress, epds*time	103.4	142.5	105.4	148.6	105.4	148.6	105.4	148.6
Intercept, time, epds, stress, and stress*time	98.8	137.7	100.8	144.0	100.8	144.0	100.8	144.0
Intercept, time, epds, stress, and stress*time, epds*time	69.4	125.6	103.8	155.7	103.8	155.7	103.8	155.7
Intercept, time, epds, stress, and history of depression	64.9	100.5	67.9	106.8	67.8	106.8	67.8	106.8
Intercept, time, epds, stress, history of depression , epds*time,	67.9	111.1	69.9	117.4	69.9	117.4	69.9	117.4

Table 3-B.4: Linear mixed model covariance structure selection results continues

Model	Covariance Structures							
	Unstructured		Compound symmetry		Autoregressive (1)		Heterogeneous AR(1)	
	AIC	BIC	AIC	BIC	AIC	BIC	AIC	BIC
Intercept, time, epds, stress, history of depression , stress*time	66.2	107.4	66.2	113.7	66.2	113.7	66.2	113.7
Intercept, time, epds, stress, history of depression , history of depression*time	66.6	107.8	66.6	114.7	66.6	114.7	66.6	114.7
Intercept, time, epds, stress, history of depression , epds*time, stress*time	67.4	119.2	69.4	125.6	69.4	125.6	69.4	125.6
Intercept, time, epds, stress, history of depression , epds*time, and history of depression *time	67.7	119.6	69.7	125.9	69.7	125.9	69.7	125.9
Intercept, time, epds, stress, history of depression , stress*time, and history of depression *time	65.3	117.2	67.3	123.5	67.3	123.5	67.3	123.5
Intercept, time, epds, stress, history of depression , epds*time, stress*time, and history of depression *time	68.8	129.3	70.8	135.6	70.8	135.6	70.8	135.6

Transition Note 2

In Chapter 3, several MI risk factors were identified in pregnant and postpartum women. While controlling other risk factors, the association of antenatal MI with PPD was found to be significant, and the trajectory of MI from early pregnancy, to late pregnancy and to postpartum had a declining trend. The study revealed that depression, history of depression, and elevated stress were risk factors for perinatal MI at T1, T2, and T3, and labour/birth complications were associated with MI at T3. The longitudinal relationship between antenatal MI and PPD was observed at T1, but not at T2, suggesting that MI during the early pregnancy was correlated with PPD at four weeks of delivery. Although the overall trajectory of MI from T1 to T3 had a decreased trend, the declining trend from T2 to T3 was significant, indicating that pregnant women experienced a significantly higher level of MI compared to postpartum women. The study also examined the trajectory of perinatal MI among groups (e.g., depressed vs. non-depressed, having a history of depression vs. no history of depression, more stress vs. less stress), and found that women who had depressive symptoms, a history of depression, or who reported more stress showed a significantly elevated level of MI from T1 to T3.

As indicated in our systematic review (Chapter 2), the research gap of perinatal MI was identified. Therefore, in Chapter 4, a third manuscript is presented to explore the effects of antenatal MI, depression, and anxiety on neonatal outcomes including 1-minute and 5-minute Apgar scores, BW, BW for gestational age, and PTB.

Chapter 4: Manuscript Three

The effects of antenatal mood instability, depression, and anxiety on neonatal outcomes

Abstract

Objective: To investigate whether antenatal mood instability (MI), depression, and anxiety are risk factors for adverse neonatal outcomes. **Method**: a total of 555 women participated in a longitudinal study of maternal depression at two points: early pregnancy (T1, 17.4 ± 4.9 weeks), and late pregnancy (T2, 30.6 ± 2.7 weeks). Mood instability, depression, anxiety, psychosocial, and behaviour variables were measured at T1 and T2, other social demographic data were collected at T1, and obstetrical and neonatal information were obtained at T3. Binary logistic regression was utilized to explore the association between antenatal MI, depression, and anxiety at T1, T2, and during pregnancy and neonatal outcomes. **Results**: In the current longitudinal study, antenatal MI and depression were found not significantly associated with adverse neonatal outcomes (low 1-minute and 5-minute Apgar scores, low birth weight (LBW), small for gestational age (SGA), and preterm birth (PTB). Antenatal anxiety was significantly associated with low 1-minute and 5-minute Apgar scores and LBW. Smoking and experiencing stress during pregnancy were found to be an independent risk factor for SGA, and being first time mothers was at a significantly higher risk for having babies with SGA and LBW. **Conclusion**: Antenatal MI and depressive symptoms do not seem to be associated with neonatal outcomes. Anxiety was found to be independently associated with neonatal outcomes. Our findings provide further evidence of the benefits of treating antenatal anxiety, encouraging smoking cessation, and the crucial need to support women in alleviating stress and maintaining mental health during pregnancy.

Keywords: antenatal women; mood instability; depression; anxiety; neonatal outcomes

4.1 Introduction

Pregnancy and childbirth are often viewed as joyful events, but can also be overwhelming and challenging for some mothers. The transition to motherhood represents a time of substantial vulnerability for women to develop mood related disturbances, including perinatal depression, anxiety (Kessler et al., 2003; Milgrom & Gemmill, 2014), postpartum blues, and mood instability (MI) (Pop et al., 2015; Reck, Stehle, Reinig, & Mundt, 2009). A meta-analysis of 102 studies determined a prevalence rate of 18.2% for antenatal anxiety in the first trimester, 19.1% in the second trimester, and 24.6% in the third trimester of pregnancy (Dennis, Falah-Hassani, & Shiri, 2017). Antenatal depressive symptoms are estimated to range from 7% to 50%, depending on the instrument used and the demographic characteristics of the study population (Gavin et al., 2005; Goedhart et al., 2010; Husain et al., 2011; Lee et al., 2007; Melville, Gavin, Guo, Fan, & Katon, 2010).

Studies have found that perinatal women often experience the highest irritable, euphoric, and depressed moods in early pregnancy and again around the time of giving birth (Cunningham et al., 2010; Steiner, Dunn, & Born, 2003). This phenomenon is thought to be triggered by the large hormonal changes that occur at these times (Buttner, O'Hara, & Watson, 2012; Cunningham et al., 2010; Fooladi, 2006). In a longitudinal study, Bowen, A. et al. (2012) investigated MI in perinatal women (n=45) and a control group consisting of normally menstruating non-pregnant women (n=31). Perinatal MI was assessed through mood diaries with visual analogue scales that measured depressed, irritable, anxious, and euphoric moods twice a day for one week at 16 weeks and 30 weeks of pregnancy, and the control group kept the diaries for two consecutive menstrual cycles or eight weeks. The findings suggest that perinatal women

significantly experienced higher levels of depressed, irritable, anxious, and euphoric mood fluctuation compared to the controls.

The monitoring of MI is a relatively new development, but a significant correlation between MI and depression or anxiety have been documented in general and clinical populations (Bowen, R., Baetz, Hawkes, & Bowen, 2006; Bowen, R, Mahmood, Milani, & Baetz, 2011; Marwaha, Balbuena, Winsper, & Bowen, 2015; Thompson, Berenbaum, & Bredemeier, 2011). The British Adult Psychiatric Morbidity Survey of 2007 (n = 7,403) found that the prevalence of MI was 13.9% among adult population, co-occurrence between MI and a depressive episode of any severity was 60.9%, and comorbidity between MI and generalized anxiety disorder was 49.2% (Marwaha, Parsons, Flanagan, & Broome, 2013).

To explain the relationship between MI and depression and anxiety, existing literature proposes that MI, depression, and anxiety share some correlates (Thompson et al., 2011). MI is a core feature of neuroticism which in turn is a risk factor for depression and anxiety (Bowen, R., Balbuena, Leuschen, & Baetz, 2012). Some have suggested that individual differences in neuroticism and negative emotionality, that are central to understanding comorbidity among psychopathologies (e.g., depression, anxiety) (Beatson & Rao, 2013; Bowen, R et al., 2011; Denollet & De Vries, 2006; Miller, D., Vachon, & Lynam, 2009; Miller, J. & Pilkonis, 2006; Quilty, Sellbom, Tackett, & Bagby, 2009). A meta-analysis of 175 studies reported a strong association between neuroticism and depression, and between neuroticism and anxiety (Kotov, Gamez, Schmidt, & Watson, 2010), while other studies indicate that negative emotionality is significantly correlated with depression and anxiety (Bekh B.et al., 2011; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). As extreme shifts in mood that last from a few hours to a few days, MI may be a result of interpersonal stress, and high levels of MI may also lead to stressful

life events (e.g., the break-up of a relationship, loss of a job) (Koenigsberg et al., 2002). The possible bidirectional effects of the relationship between stress and depression, and between stress and anxiety have been confirmed by Cui and Vaillant (1997) and Hammen (2005).

One UK study of 83,545 participants investigated the relationship between LBW and maternal neuroticism, and found that they are significantly associated, and the positive correlation between LBW and major depression disorder is partially mediated by higher maternal neuroticism (Lyall et al., 2016). However, the neonatal outcome variables were not based on clinical records, rather based on the mothers' retrospective recall. Research has identified the association between neonatal outcomes and antenatal depression and/or anxiety. However, the findings are inconsistent. While some studies have found a significant relationship between antenatal depression and/or anxiety and LBW, PTB, SGA, and/or low Apgar score (Field et al., 2008; Goedhart et al., 2010; Nasreen, Kabir, Forsell, & Edhborg, 2010; Saeed, Raana, Saeed, & Humayun, 2016), while others have not (Andersson, Sundström-Poromaa, Wulff, Åström, & Bixo, 2004; Evans, J., Heron, Patel, & Wiles, 2007; Flynn, McBride, Cely, Wang, & DeCesare, 2015; Neggers, Goldenberg, Cliver, & Hauth, 2006). A literature review (Chapter 2 in this dissertation) was unable to locate research that identified an association between antenatal MI and neonatal outcomes.

4.2 Research hypothesis

Antenatal MI, depression, and anxiety would be associated with neonatal outcomes (LBW, SGA, PTB, low 1-minute and 5-minute Apgar score) at 17 and 31 weeks of pregnancy.

4.3 Methods

4.3.1 Participants and procedure

The current study is a secondary data analysis of the Feelings in Pregnancy and

Motherhood Study (FIP), which was funded by the Canadian Institutes of Health Research, and the subsequent Feelings in Pregnancy and Motherhood Study: Child and Maternal Outcomes (Grant # 145179). The FIP is a longitudinal cohort study of maternal mental health and the associated factors from 2006 to 2014. A total of 648 women were recruited in early pregnancy from a variety of community settings such as doctors' offices, prenatal classes, maternity stores, and responders to radio and newspaper advertisements. The inclusion criteria were English speaking women in early pregnancy (gestation ≤ 20 weeks), and a resident in one of two health regions in Saskatchewan (Saskatoon Health Region or Five Hills Health Region). Data collection was conducted by trained research assistants through a face-to-face interviews at three-time points: T1 early pregnancy (17.4 ± 4.9 weeks), T2 late pregnancy (30.6 ± 2.7 weeks), and T3 postpartum (4.2 ± 2.1 weeks). Information regarding children's birth outcomes were obtained from the mothers and linked with hospital discharge records, with the mother's permission. Ethics approval for the research protocol was obtained from the Behavioural Research Ethics Board at the University of Saskatchewan. All participants gave written informed consent. If a woman screened positive for depression, she was referred with her permission to her family doctor for further investigation and given information about local mental health services; if she was deemed at risk of self-harm or harming others, immediate help was provided.

4.3.2 Measures

Depression. Depressive symptoms were measured using the Edinburgh Postnatal Depression Scale (EPDS) (Cox, Holden, & Sagovsky, 1987). The EPDS is the most widely used self-report measure for screening postnatal depression (Matthey, S, Henshaw, Elliott, & Barnett, 2006). Respondents select one of four possible responses (0-3) to each of ten questions to indicate how they felt in the previous week. Ratings for the individual items are summed for a

possible maximum score of 30 (range 0-30; 0 = not depressed, 30 = highest score of depressive mood). Validation studies of the EPDS have been conducted in different cultures, languages, and settings, including in Saskatchewan (Clarke, 2008; Cox & Holden, 2003). The EPDS has been found to have a sensitivity of 80% and specificity of 87% (Matijasevich et al., 2014). A cut-off score of ≥12 depressed was used in this present study to determine depressive symptoms (Husain et al., 2014; Murray & Cox, 1990; Smith, Eryigit-Madzwamuse, & Barnes, 2013).

The EPDS has been extensively validated as a screening tool for perinatal depression (Clarke, 2008; Matijasevich et al., 2014), and it was assumed to be a uni-dimensional instrument for assessing depressive symptoms (Cox et al., 1987). However, studies have indicated that there is underlying factor structure of the EPDS, which suggests that the EPDS also measures anxiety symptoms (Bowen, A., Bowen, Maslany, & Muhajarine, 2008; Ross, Evans, Sellers, & Romach, 2003). Psychometric properties of EPDS have been investigated by utilizing exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). For example, Brouwers et al. (2001) conducted an EFA on the EPDS in 197 women at 24 weeks gestation, and found that the instrument is comprised of three-factors: “depression ” (items 1, 2, and 8), “anxiety” (items 3, 4, and 5), and a single item factor “self-harm” (item 10).

A subsequent study of 402 socially high-risk women at 15 weeks of gestation identified the similar factor structure (Bowen, A. et al., 2008). Other studies also found a three-factor model, but the factor representing depression included different sets of items. For example, Jomeen and Martin (2005) carried out EFA and CFA on the EPDS among an antenatal cohort of 101 women at 14 weeks of gestation, and found that the factor of depression consists of items 1, 2, 6, 7, 8, and 9 and the factor of anxiety includes items, 3, 4, and 5, and single item 10 for the factor of self-harm. Ross et al. (2003) utilized EFA on the EPDS in 150 women between 36-40

weeks of pregnancy, and 6 and 16 weeks of postpartum, and found that the factor of depression is comprised of items 1, 2, 8, and 9 and the factor for anxiety includes items 3, 4, and 5, and the third factor includes item 10 for self-harm. Although the items for depression varied across studies, the items of the factor for anxiety were relatively consistent.

Anxiety. Anxiety symptoms were measured at T1, and T2 using the EPDS anxiety subscale (items 3, 4, and 5) (Bowen, A. et al., 2008; Buist, Gotman, & Yonkers, 2011; Kabir, Sheeder, & Kelly, 2008; Tuohy & McVey, 2008). Jomeen and Martin (2005) found that factor loadings for items 3, 4, and 5 were 0.73, 0.85, and 0.75 respectively. Cronbach α of 0.77 indicates an acceptable level of internal consistency (Phillips, Charles, Sharpe, & Matthey, 2009). In clinical settings, a cut-off score of ≥4 is used to indicate significant anxiety symptoms (Phillips, Charles, Sharpe, & Matthey, 2009); however, a cut-off score of ≥ 6 has been used in community samples (Matthey, Stephen, 2008). Consequently, a cut-off score of ≥ 6 was used to measure anxiety symptoms in the current study.

Mood instability. Mood instability was measured using a five-item visual analogue scale (VAS) at T1 and T2: 1 "mood frequent ups and downs", 2 "mood swings occur for no reason", 3 "other people complain about your mood swings", 4 "having trouble following through with plans because of mood swings", and 5 "not making commitments because moods might change". Women were asked to mark an "X" on a 10cm line to indicate their level of MI. The X was then interpreted on a metric ruler by a trained research assistant, with random audit by a second trained research assistant to assure accuracy. This self-reported measure has a total possible score of 50 (0-50).

Sociodemographic factors

- Age: women's ages were calculated based on their birthday at the time of intake. Seventeen women were less than 20 years old, and six women were older than 40 years of

age, thus the variable was dichotomized as either <25 years or ≥ 25 years old.

- Education attainment: women reported years of education they received as < 12th grade, completed 12th grade, some post-secondary/university, and completed post-secondary/university. The variable was categorized into < grade 12 and ≥ grade 12.
- Marital status: participants were in different relationship arrangements, and this variable was categorized as with a partner (married or cohabiting) or without a partner (single, widowed, or divorced).
- Ethnicity: options included Caucasian, Aboriginal with treaty status, non-status Aboriginal, Métis, immigrant, and other. Due to the small number of women who were immigrants or other, the ethnicity of women was dichotomized as Aboriginal or non-Aboriginal.
- Family income: four levels of family income were identified: social assistance or less than $20,000 per year, between $20,000 and $40,000 per year, between $40,000 and $60,000 per year, and greater than $60,000 per year. This variable was categorized as ≤$40,000 or > $40,000.

Psychosocial factors

- Social support: six questions inquired about the types of support available (emotional support, support of a partner, support of the mother, support of friends, support of female relatives, and other support). The variable was dichotomized as low-level of support (0-1 types support) and high-level of support (two or more types of support).
- Stressors: women were asked to identify their sources of stress including being pregnant, health of baby, birth of baby, own health, relationship with partner, housing, money, and work. The level of stress was categorized into low-stress level (0-2 stressors) or high-stress

level (≥ 2 stressors).

Behavioral factors

- Smoking: women were asked, "In the last month, how much do you smoke?" Options included more than a pack/day, 5-20 cigarettes/day, less than five cigarettes a day, quit since pregnant, quit before pregnancy, and never smoked. The variable was categorized into a dichotomized variable, "yes" and "no or quit".
- Alcohol: alcohol use was assessed by asking, "How often did you drink beer or other alcohol?" Potential responses were occasional on a drink or two, 1-2 drinks a day, five or more drinks at one time, quit since pregnant, quit before pregnancy, and never drank alcohol. The variable was summarized into a dichotomized variable, "yes" and "no or quit".
- Drug: Drug use behaviour was determined by asking "How often did you use drugs such as marijuana, crystal meth, and cocaine?" Potential responses included regularly (every day), occasionally, quit since pregnancy, quit before pregnancy, and never use such drugs. The options were summarized into a dichotomized variable, "yes" and "no or quit".
- Exercise: "In the last month, how much do you exercise?" was used to evaluate women's exercise regimen, and women's answers were every day, 2-3 times per week, occasionally, or never. The responses were categorized into a dichotomous variable with two levels, "regular exercise" and "never or occasionally exercise."

Obstetric outcome factors

- Pregnancy intention: intention was categorized into "yes" based on women's response to "intended pregnancy", and "no" for not intended.
- Parity: the total number of pregnancies, previous abortions and/or miscarriages, and previous preterm and/or full-term deliveries. The variable was summarized into a

dichotomous variable, "1" for primigravida and ">1" for multigravida.

Neonatal outcome factors

- One and five minute Apgar scores: the Apgar scores measures a baby's wellbeing at birth by assessing five areas at 1, 5, and sometimes 10 minutes after birth: activity, pulse, grimace, appearance, and respiration (Apgar & Beck, 1972). Each area is rated from 0 to 2 with a possible total score of 10 (scores above 7 indicate that baby is doing well). Apgar scores were dichotomized as <7 or ≥ 7 (Apgar & Beck, 1972).
- Birth weight (BW): weight was measured in grams and dichotomized into two levels: <2500 g and ≥2500 g (Wardlaw, 2004).
- BW for gestational age: if the baby's weight is within the 10^{th} and 90^{th} percentiles for its gestational age, it is considered appropriate for gestational age (AGA), while SGA is indicated if the baby's weight is below the 10^{th} percentile for gestational age, and large for gestational age (LGA) if baby's weight is above the 90^{th} percentile for gestational age (Kramer et al., 2001). Birth weight for gestational age was dichotomized into two levels (original score categories above 10^{th} percentile were collapsed to obtain a manageable number to perform logistic regression): AGA/LGA and SGA.
- PTB: preterm is based on the duration of pregnancy in completed weeks from the first day of the last normal menstrual period to birth. The variable was dichotomized into two levels: pre-term birth (< 37 weeks) and non-pre-term birth (≥ 37 weeks) (Eisfeld, 2014).

4.3.3 Data Analysis

We summarized with descriptive statistics the characteristics of mothers and babies (e.g., PTB, BW, BW for gestational age, 1-minute Apgar score, and 5-minute Apgar score). At T1, the first 93 women had participated in the study before the MI assessment was added to the study;

therefore, they were excluded in the study, and data were analyzed on 555 women. For group comparison, depressive and anxiety levels were cross-tabulated against the baby's Apgar scores, BW, BW for gestational age, and PTB at T1 and T2.

To examine the relationship between EPDS anxiety subscale, EPDS depression subscale with three items, EPDS depression subscale with six items, and MI at T1 and T2, Pearson's correlation coefficients were conducted on anxiety (EPDS subscale: items 3, 4, and 5), depression (EPDS subscales: items 1, 2, and 8, and items 1, 2, 6, 7, 8, and 9), and MI at T1 and T2. To evaluate internal reliability consistency, a Cronbach α for EPDS score (10 items, 6 items, and 3 items), EPDS anxiety subscale score, and MI score was computed.

Model selection and model fit diagnostic. Binary logistic regression was used to predict probabilities that variables fall into one of two categories as a function of explanatory variables (Kleinbaum & Klein, 2010). We conducted the data analysis for T1, T2, and during pregnancy (T1 + T2). Neonatal outcomes were dependent variables (DVs), and MI, depressive, and anxiety symptoms, and other variables (demographic, psychosocial, and behavioural) were independent variables (IVs). For IVs during pregnancy, MI, as a continuous variable, was averaged ((T1 + T2)/2), and other dichotomous variables including sociodemographic, psychosocial, behavioral, obstetric, and neonatal variables that were measured at T1 and T2) were added (T1 + T2) (for example, a woman experienced depression during pregnancy, indicating she was depressed at T1 or at T2, or both) (Anand et al., 2005; Dotson, Resnick, & Zonderman, 2008). We also conducted the data analysis on anxiety (EPDS subscale) as a continuous variable at T1 and T2, and for depressive symptoms (EPDS) as continuous variable including 10 items, 6 items (items 1, 2, 6, 7, 8, and 9), and 3 items (items 1, 2, and 8) at T1 and T2 based on literature search. For each of T1 and T2, and during pregnancy, the association of neonatal outcomes with antenatal

MI, depression, anxiety, and other risk factors was investigated. In particular, we determined whether MI, depression, anxiety symptoms, and other risk factors were associated with (i) 1-minute Apgar, (ii) 5-minute Apgar, (iii) BW, (iv) BW for gestational age, and (v) PTB.

For model selection in binary logistic regression analysis, the backward elimination model building process followed five steps (Montgomery, Peck, & Vining, 2015): 1) keep variables with p-value <0.25 in the univariate analysis; 2) fit the multivariable model containing all covariates identified from inclusion in step 1; 3) in each step of backward selection procedure in step 2, compare the values of the estimated coefficients in the smaller model to their corresponding value from the large model. Any variable whose coefficient has changed substantially in magnitude (e.g., $\Delta\beta$>20%) was put back to refit until the important variables are included; 4) put each variable not selected in step 1 to the model obtained at step 3, one at a time, and check its significance by the Wald statistic and p-value; 5) put all variables that were significant (p-value <0.05) at Step 4 in the final model.

Multicollinearity diagnostic statistics (tolerance and variance inflation factors (VIF)) were tested, and the values of VIF were < 10, indicating that there was no violation of multicollinearity assumption (Brown, Giles, & Greenlund, 2007). The Hosmer and Lemeshow goodness-of-fit test was utilized in assessing model fit, and non-significant values (p > 0.05) indicates that the model prediction does not significantly differ from the observed (Kleinbaum & Klein, 2010).

Coefficients in logistic regression models were exponentiated to yield odds ratios (OR) and their 95% confidence intervals (CI) were calculated accordingly. Results were considered to provide evidence of significance if p-values <0.05 (α level of 5%). The data were analyzed using the SAS 9.3 program.

4.4 Results

4.4.1 Descriptive data analysis

Variables of interest for accuracy of skewness, Kurtosis, and outliers were examined. Univariate outliers were detected in some variables (MI and EPDS scores) by using box plot and histogram. Univariate outliers were detected in all study variables, but the outliers were not excluded as they represented clinically relevant cases of depression, anxiety, and MI (such as EPDS = 30 or EPDS = 1). The 5% trimmed means were similar to the original means of all variables (Maronna, Martin, & Yohai, 2006).

The mean age of participants was 29.0 years (*SD* =4.85) and 38.1% (n = 211) of women were primiparaous. The majority of the women lived with a partner (91.9%, n = 510), 95.8% (n = 530) of women had education level of high school diploma or higher, 70.1% (n = 371) of the family income was equal or greater than $40,000 per year, and Aboriginal women represented 7.2% (n = 39) of the women. Almost half of the women (49.3%, n = 271) reported experiencing more stress at T1, and 234 (45.7%) at T2; 67 (12.7%) women reported receiving low social support, and 11.9% (n = 61) at T2; Sixty (10.9%) women smoked at T1, and 10.7% (n = 55) at T2; 38 (6.9%) women used alcohol at T1, and 3.6% (n = 20) at T2; 16 (2.9%) women used drugs at T1, and 1% (n = 5) at T2; 298 (53.9%) women reported having a regular exercise routine at T1, and 283 (55.1%) at T2.

The mean score and standard deviation of EPDS (10 items, 6 items, and 3 items), EPDS anxiety subscale, and MI at T1 and T2 are presented in Table 4.1. The Cronbach α for EPDS (10 items and 6 items for depression subscale) and MI measurements indicates high internal consistency at T1 and T2, and an acceptable level of internal consistency for EPDS anxiety subscale at T1 and T2, and EPDS 3 items for depression subscale (Cronbach, 1951) (Table 4.1).

Table 4.1: Mean scores of EPDS, EPDS anxiety subscale, and MI, and Cronbach α

Measurements (N)	Mean	*SD*	Depression (%) /Anxiety (%)	Cronbach α
EPDS score at T1 (10 items) (554)	6.8	4.6	12.5	0.832
EPDS score at T2 (10 items) (523)	6.3	4.3	10.7	0.825
EPDS score at T1 (6 items) (554)	3.4	2.9		0.818
EPDS score at T2 (6 items) (523)	3.2	2.8		0.797
EPDS score at T1 (3 items) (554)	1.3	1.5		0.711
EPDS score at T2 (3 items) (523)	1.3	1.4		0.633
Anxiety score at T1 (554)	3.3	2.1	10.2	0.722
Anxiety score at T2 (523)	3.0	1.9	8.6	0.703
MI score at T1 (554)	14.2	11.0		0.845
MI score at T2 (513)	14.1	9.4		0.867

Sixty-eight (13.2%) babies had a 1-minute Apgar score < 7, while 15 (2.9%) babies had a 5-minute Apgar of <7. Only 20 (3.9%) of the baby's BW were <2500g, while 44 (8.6%) of baby's BW were 10^{th} percentile for gestational age, indicating SGA. Thirty-two babies were born preterm (6.3%) (Table 4.2).

Table 4.2: Birth outcomes characteristics

Birth outcome (N)	Mean	*SD*	Categorical thresholds	N (%)
1-minute Apgar score (515)	7.83	1.47	< 7	68 (13.2)
5-minute Apgar score (517)	8.73	0.94	< 7	15 (2.9)
Birth weight (grams) (513)	3459	588	< 2,500 g	20 (3.9)
Birth weight for gestational age (512)			$<10^{th}$ percentile for gestational age	44 (8.6)
PTB (week) (508)	39.2	1.78	< 37 weeks	32 (6.3)

For group comparison, depressive and anxiety levels were cross-tabulated against baby's Apgar scores, BW, BW for gestational age, and PTB at T1 and T2, and only anxiety at T1 and T2 were significantly associated with low 1-minute and 5-minute Apgar score (X^2 (1, N = 507) = 11.459, p = 0.003; X^2 (1, N = 506), p = 0.035 respectively) (Appendix 4-A, Table 4-A.1).

The Pearson correlation coefficients between the EPDS anxiety subscale, EPDS-3 item depression subscale, EPDS-6 item depression subscale, and MI at T1 and T2, and means and standard deviations of above variable are provided in Table 4.2. The EPDS anxiety subscale at T1 was moderately correlated with EPDS-6 items depression subscale, and was weakly correlated with EPDS-3 items depression subscale and MI (Ghassemzadeh, Mojtabai, Karamghadiri, & Ebrahimkhani, 2005). The EPDS anxiety subscale at T2 was moderately correlated with EPDS-6 items depression subscale and MI, and a weak correlation between EPDS-3 items depression subscale and EPDS anxiety subscale was displayed. Mood instability at T1 was weakly correlated with both EPDS-6 and EPDS-3 items depression subscales, while MI at T2 was moderately correlated with both EPDS-6 and EPDS-3 items depression subscales (Table 4.3).

Missing values were examined. At T1, MI data was not available on 93 women because MI assessment was not yet available in the study. Logistic regression data analysis was carried out with 555 women. Missing values in this study at T1 and T2 accounted for less than 10%, which is at an acceptable level (Bennett, 2001).

Table 4.3: Mean, standard deviation, and correlations for the key study variables (EPDS, GAD7, MDQ, ALS-18 three factors, and ALS-18 six factors)

	M	(SD)	EPDS subscale Anxiety1	EPDS1 depression (3 items)	EPDS1 depression (6 items)	MI1	EPDS subscale Anxiety2	EPDS2 depression (3 items)	EPDS2 depression (6 items)	MI2
EPDS subscale Anxiety1	3.32	2.06	1.00							
EPDS1 depression (3 items)	1.27	1.44	0.32**	1.00						
EPDS1 depression (6 items)	3.40	2.98	0.57**	0.38**	1.00					
MI1	14.23	10.93	0.48**	0.33**	0.57**	1.00				
EPDS subscale Anxiety2	2.97	1.91	0.56**	0.49**	0.38**	0.38**	1.00			
EPDS2 depression (3 items)	1.27	1.44	0.32**	1.00**	0.38**	0.33**	0.49**	1.00		
EPDS2 depression (6 items)	3.25	2.82	0.36**	0.90**	0.44**	0.36**	0.57**	0.90**	1.00	
MI2	14.11	9.38	0.38**	0.57**	0.41**	0.56**	0.53**	0.57**	0.63**	1.00

Note: Anxiety1, EPDS1 and MI = Time 1, Anxiety2, EPDS2, and MI2 = Time 2, Anxiety = EPDS anxiety subscale (item 3, 4, and 5), EPDS subscale depression 3 items (1, 2, and 8), EPDS subscale depression 6 items (1, 2, 6. 7, 8 and 9)

[a] 2-tailed Pearson Correlation: * $p < 0.05$, ** $p < 0.01$

4.4.2 Effects of antenatal mood instability, depression, and anxiety on neonatal outcomes

Univariate logistic regression showed that anxiety as a dichotomous variable was significantly associated with 1-minute Apgar and 5-minute Apgar scores at T1, T2, and during pregnancy (during pregnancy = T1 + T2, as described earlier); unintended pregnancy was linked to SGA at T1, T2, and during pregnancy; first time pregnancy was correlated with LBW, and SGA at T1, T2, and during pregnancy; higher education attainment seemed to protect women against preterm birth. More stressors in late pregnancy were associated with SGA; smoking at T1 and T2 was linked to SGA; regular exercise during pregnancy showed as a protective factor for LBW. Finally, illicit drug use was identified as a risk factor for LBW at T1, and PTB at T1 and during pregnancy. The univariate analysis for drug use was carried out at T1, but not at T2, due to insufficient data (only 5 women used drug at T2). The results of univariate logistic regression are reported in Appendix 4-B, Table 4-B.1-15.

Univariate logistic regression for anxiety as a continuous variable revealed no significant association between anxiety and neonatal outcomes at T1 and T2 (Appendix 4-B, Table 4-B.1-15). For depressive symptoms (EPDS) treated as a continuous variable including 10 items, 6 items (item 1, 2, 6, 7, 8, and 9), and 3 items (item 1, 2, and 8) at T1 and T2, no significant associations were found with neonatal outcomes (Appendix 4-B, Table 4-B.1-15).

The multivariate logistic regression revealed that in early pregnancy, primiparity was significantly associated with LBW and SGA, and smoking was a significant risk factor for SGA. At 31 weeks of pregnancy, anxiety as a dichotomous variable was significantly associated with Apgar scores <7 at 1-minute and 5-minutes after birth and LBW, parity was significantly associated with LBW and SGA, and smoking and stress were significantly linked to SGA. During pregnancy, anxiety as a dichotomous variable was significantly associated with Apgar

score <7 at 1-minute and 5-minutes after birth, parity was strongly linked to LBW and SGA, and smoking was identified as a risk factor for SGA. No risk factor was significantly correlated with PTB at T1, T2, and during pregnancy.

Although unintended pregnancy was significantly associated with SGA at T1, T2, and during pregnancy, and regular exercise was a protective factor for LBW during pregnancy in univariate logistic regression, they did not reach significance in the multivariate logistic regression. Table 4.4 summarizes the statistically significant effects of independent variables on 1-minute Apgar, 5-minute Apgar score, BW, BW, and PTB while holding all other variables constant.

The values of VIF for the multivariate logistic models were < 10, indicating that there was no violation of multicollinearity assumption (Brown et al., 2007). The model fit was assessed by examining Hosmer and Lemeshow goodness-of-fit tests, which were non-significant ($p > 0.05$) indicating that the multivariate logistic regression models prediction does not significantly differ from the observed data (Kleinbaum & Klein, 2010).

Table 4.4: Association of MI, depression, anxiety, and other risk factors with 1-minute and 5-minute Apgar score, LBW, SGA and PTB at T1, T2, and T1+T2 (multiple logistic regression results)

Measure (N)	Risk factor	Odds ratio (95%CIs)	*p*-value
T1 (N = 501)			
1-minute Apgar (< 7)	No risk factor was significant		
5-minute Apgar (<7)	No risk factor was significant		
LBW (< 2500g)	Parity (primigravida vs. multigravida)	2.604 (1.045 - 6.491)	0.040
SGA (<10th percentile)	Smoking (smoker vs. non-smoker)	5.472 (2.392 - 2.520)	<0.0001
SGA (<10th percentile)	Parity (primigravida vs. multigravida)	3.905 (1.963 - 7.767)	<0.0001
PTB (< 37 weeks)	No risk factor was significant		
T2 (N = 498)			
1-minute Apgar (< 7)	Anxiety	3.344 (1.609 - 6.950)	0.001
5-minute Apgar (< 7)	Anxiety	4.103 (1.223 - 3.764)	0.022
LBW (< 2500g)	Anxiety	3.949 (1.144 -13.630)	0.030
LBW (< 2500g)	Parity (primigravida vs. multigravida)	2.967 (1.063 – 8.283)	0.038
SGA (<10th percentile)	Smoking (smoker vs. non-smoker)	5.316 (2.241 -12.612)	<0.0001
SGA (<10th percentile)	Parity (primigravida vs. multigravida)	3.848 (1913 - 7.741)	<0.0001
SGA (<10th percentile)	Stressors (more stressors vs. less stressors)	2.255 (1.104 - 4.606)	0.026
PTB (< 37 weeks)	No risk factor was significant		
T1 + T2 (N = 505)			
1-minute Apgar (< 7)	Anxiety	2.875 (1.122 – 7.364)	0.028
5-minute Apgar (< 7)	Anxiety	6.174 (1.569 – 14.293)	0.009
LBW (< 2500g)	Parity (primigravida vs. multigravida)	2.882 (1.029 – 8.070)	0.044
SGA (<10th percentile)	Smoking (smoker vs. non-smoker)	5.486 (2.398 – 12.551)	<0.0001
SGA (<10th percentile)	Parity (primigravida vs. multigravida)	3.917(1.970 – 7.790)	<0.0001
PTB (< 37 weeks)	No risk factor was significant		

4.5 Discussion

To the best of our knowledge, this is the first study to report the relationship between antenatal MI and neonatal outcomes. The positive relationship between MI and depression or anxiety in general and clinical samples has explained by alluding to shared correlates: neuroticism, negative emotionality, and stress (Thompson et al., 2011). Marwaha et al. (2013) revealed high comorbidity among MI, depression, and anxiety in a large population-based survey. The lack of research on perinatal MI and its effects on the developing fetus limits our ability to discuss the findings in relation to other literature, but the growing research on the relationship between MI and depression, anxiety, and stress, and the extensive studies on mechanisms of the relationship between neonatal outcomes and maternal depression, anxiety, and stress serve as a basis for examining the reason that MI might have an impact on the fetus and newborn.

One study investigated the relationship between LBW and neuroticism in 83,545 participants in the UK, and found that they are significantly associated, and the positive correlation between LBW and major depressive disorder is partially mediated by higher neuroticism (Lyall et al., 2016). The association between neonatal outcomes and maternal depression and/or anxiety has been well documented; therefore, the findings will be discussed in relation to mood problems in general.

Studies have postulated potential causal pathways of the relationship between fetal exposure to stress and antenatal depression, anxiety, and stress. Maternal hypothalamic-pituitary-adrenal (HPA) axis changes have been proposed in the etiology of adverse birth outcomes. Over the course of gestation, maternal HPA axis activity increases (King, Nicholson, & Smith, 2001). Evans et al. (2008) found that an elevated level of anxiety during pregnancy may result in an

increase in stress hormones such as cortisol and catecholamines. Fetal exposure to the elevated level of stress hormones has been associated with fetal growth restriction and LBW (Bloom, Sheffield, McIntire, & Leveno, 2001; Murphy, Smith, Giles, & Clifton, 2006). In addition, placental enzyme 11β-hydroxysteroid dehydrogenase-2 (11β-HSD-2) may account for decreased transfer of maternal cortisol to the fetus by converting cortisol to its inactive form of cortisone, which served as a physiological 'barrier' to maternal glucocorticoids (O'Donnell et al., 2012). Overexposure to maternal glucocorticoids induced by downregulation of 11β-HSD2 mRNA expression leads to LBW and disruptions in fetal growth (Ellman et al., 2008).

Studies of the relationship between antenatal depression and neonatal outcomes have been inconsistent. The positive relationship in developing countries was proposed to be related to low socioeconomic status (SES) in women who face a greater challenge of comorbid risk factors (e.g., maternal undernutrition) (Black et al., 2008; Diego et al., 2009). A meta-analysis by Grote et al. of 29 studies (2010) investigated possible moderators of neonatal outcomes, and found the country in which the study was conducted (developed or developing country) was a significant moderator of the association between antenatal depression and LBW. However, Goedhart et al. (2010) conducted a study of 8,050 women at 12 weeks of pregnancy in Holland (developed country), and found a positive relationship between perinatal depression and neonatal outcomes. Furthermore, in a study by Nasreen et al. (2010), 720 women in their 3rd trimester from two rural subdistricts of Bangladesh (developing country) were assessed by using EPDS to determine depressive status, and the finding showed a significant relationship between antenatal depression and LBW while controlling for poverty and maternal nutritional status.

The relationship between antenatal depression and SGA/PTB/LBW/Apgar score was not significant in the current study, which is in agreement with some studies (Andersson et al., 2004;

Berle et al., 2005; Flynn et al., 2015; Larsson, Sydsjö, & Josefsson, 2004), whereas other studies have reported a positive association (Dayan et al., 2006; Goedhart et al., 2010; Li, Liu, & Odouli, 2008). The major reasons for the divergent findings might be related to differences in measurement of depression, gestational age, and the samples. For example, in Li, Liu and Odouli's study (2008), 791 women in their early pregnancy (around 10 weeks gestation) from the US were assessed for depression using the Center for Epidemiological Studies Depression Scale (CESD). Studies found that CESD tends to produce higher scores and more false-positive results in symptomatic pregnant and postpartum women (Gaynes et al., 2005; Logsdon & Myers, 2010; Mosack & Shore, 2006). In this diverse sample of 38.1% Caucasian, 28.6% Asian or Pacific Island, 21.0% Hispanic, and 6.8% African American women, a positive association between depression and PTB was found. Similar findings were reported in a study including 959 Chinese women in late pregnancy using the Beck Depression Inventory to assess women's depressive status (Chung, Lau, Yip, Chiu, & Lee, 2001). Berle et al. (2005) found a negative association between depression and PTB in 680 Norwegian women at 16 weeks gestation by the Hospital Anxiety and Depression Rating Scale.

Elevated anxiety level at 31 weeks of pregnancy has been associated with LBW, and 1-minute and 5-minute Apgar scores, and experiencing higher level of stress at 31 weeks of pregnancy was correlated with SGA, which replicates other studies (Andersson et al., 2004; Khashan et al., 2014; Loomans et al., 2012; Nasreen et al., 2010). However, not all studies have demonstrated such an association (Andersson et al., 2004; Berle et al., 2005), which might be related to the timing of when antenatal anxiety and stress were measured in pregnancy (Glover, O'Connor, & O'Donnell, 2010; Khashan et al., 2014). While others suggest that the mechanisms

of the association between stress and neonatal outcomes are not well understood (Beijers, Buitelaar, & de Weerth, 2014; Zijlmans, Riksen-Walraven, & de Weerth, 2015).

Smoking at T1 and T2 was a risk factor for SGA, which is in agreement with other studies (Chiolero, Bovet, & Paccaud, 2005; Raatikainen, Huurinainen, & Heinonen, 2007; Suzuki et al., 2008). Antenatal cigarette smoking leads to fetal exposure to nicotine, which crosses the placenta and leads to a 15% higher concentration than in maternal blood (Bruin, Gerstein, & Holloway, 2010; Cnattingius, 2004). Nicotine interferes with normal placental function, and reduces uterine blood flow by an average of 30 to 49%, which causes deprivation of nutrients and oxygen, resulting in fetal hypoxia and malnutrition, and may lead to intrauterine growth restriction (Bruin, Gerstein, & Holloway, 2010; Florescu et al., 2009).

Being primiparous was associated with LBW and SGA in the current study, which is consistent with some studies (Shah, 2010). A meta-analysis of 41 studies found that being primiparous increased a woman's risk of having a baby with LBW and SGA (Shah, 2010). Parity influences growth of the placenta and its efficiency, which is related to uterine blood flow, oxygen availability, nutrient exchange, and endocrine regulation of the fetus (Fowden, Sferruzzi-Perri, Coan, Constancia, & Burton, 2009; Roland et al., 2012).

4.6 Limitations

Although this is a relatively large sample, the participants were predominantly Caucasian, married, with post-secondary education, and higher family income. According to the 2016 Census of Canada (Statistic Canadian, 2018), 25.8% of females between 25 and 34 years old, and 24.4% of females between 35 and 44 years old in Saskatchewan have a high school diploma or higher education (there was no information on women 18-25 years old, and only had 15 years old and over) compared with 70.1% of the current sample. In addition, Aboriginal people

accounted for 15.6% of the total population of Saskatchewan compared with 7.2% in this sample (Statistic Canadian, 2018). This limits the generalizability of the results to women who have lower education attainment, and who are aboriginal. Reports of MI, depression, and anxiety relied on participants' subjective, and retrospective recall, which can be influenced by cognitive processes used to reconstruct past events (Schwartz & Rapkin, 2004).

4.7 Conclusion

We believe that this prospective study is the first known reported study of the relationship between MI in pregnancy and neonatal outcomes. Our analysis identified no association between antenatal MI or depression and neonatal outcomes, however, antenatal anxiety was associated with an increased risk of LBW and low 1 and 5-minute Apgar scores. Other key findings confirm previous research that less stress during late pregnancy is a protective factor for SGA, non-smoking or quitting smoking during pregnancy decreases the odds of having a baby with SGA, and being primiparous was significantly associated with LBW and SGA. While the inconsistent research findings have been documented in the relationship between mood disorders such as depression and anxiety and neonatal outcomes, the current study of MI and its relationship with anxiety and depression contribute to the discussion. Our findings provide further evidence of the benefits of smoking cessation, and the crucial need to support women in alleviating stress and remaining mentally healthy during pregnancy.

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4.9 Appendix 4-A: Table of results of group comparisons

Table 4-A.1: Group comparisons (women with depression vs. without; women with anxiety vs. without) - Chi-square test results

	One-minute Apgar (<7)	Five-minute Apgar (<7)	Birth Weight (<2500g)	Birth Weight for gestational age (<10th percentile)	Preterm birth (<37 weeks)
			T1		
Anxiety	X^2 (1, N = 509) = 0.007, p = 1.000	X^2 (1, N = 513), p = 0.240*	X^2 (1, N = 508), p = 0.494*	X^2 (1, N = 510) = 0.295, p = 0.658	X^2 (1, N = 500), p = 0.801*
Depression	X^2 (1, N = 510) = 105, p = 0.745	X^2 (1, N = 515), p = 0.427	X^2 (1, N = 509), p = 0.494	X^2 (1, N = 509) = 0.070, p = 0.792	X^2 (1, N = 501), p = 0.586
			T2		
Anxiety	X^2 (1, N = 507) = 11.459, p = 0.003	X^2 (1, N = 506), p = 0.035*	X^2 (1, N = 505), p = 0.077*	X^2 (1, N = 504), p = 0.242*	X^2 (1, N = 500), p = 0.323*
Depression	X^2 (1, N = 509) = 0.395, p = 0.529	X^2 (1, N = 508), p = 0.640*	X^2 (1, N = 507), p = 0.677*	X^2 (1, N = 503), p = 0.579*	X^2 (1, N = 501), p = 0.328

*Fisher's exact test used due to at one cell count <5.

4.10 Appendix 4-B: Tables of association between antenatal MI and neonatal outcomes

Table 4-B.1: Summary of univariate association between antenatal MI and other risk factors at T1 and Apgar at 1 minute

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*P* value
Mood instability (continuous) (513)	513	1.008 (0.974 – 1.023)	0.957
Marital status (515)		1.678 (0.733 – 3.845)	0.221
Without partner	42 (8.1)		
With partner	473 (91.9)		
Education (515)		1.013 (0.552 – 1.859)	0.967
< high school diploma	22 (4.2)		
≥ high school diploma	493 (95.8)		
Ethnicity (515)		1.594 (0.470 – 5.408)	0.454
Aboriginal	37 (7.2)		
Non-Aboriginal	478 (92.8)		
Family income (515)		1.347 (0.766 – 2.367)	0.301
≤$40,000	154 (29.9)		
>$40,000	361 (70.1)		
Age (515)		1.243 (0.564 - 2.738)	0.590
<25	83 (16.2)		
≥ 25	432 (83.8)		
Depression (510)		1.025 (0.916 - 1.041)	0.746
EPDS ≥12	64 (12.5)		
EPDS <12	446 (87.5)		
Depression as continuous variable (10 items) (510)		1.012 (0.952 – 1.076)	0.707
Depression as continuous variable (6 items) (510)		1.047 (0.948 – 1.156)	0.365
Depression as continuous variable (3 items) (510)		0.984 (0.816 – 1.187)	0.869
Anxiety (509)		1.032 (0.496 – 2.145)	0.934
EPDS subscale ≥6	52 (10.2)		
EPDS subscale <6	457 (89.8)		
Anxiety as continuous variable (509)		0.978 (0.860 – 1.113)	0.739
Stress level (509)		1.167 (0.695 – 1.960)	0.560
More (>2)	251 (49.3)		
Less (0-2)	258 (50.7)		
Social support (510)		1.387 (0.679 – 2.834)	0.476
Less (0-1)	65 (12.7)		
More (≥2)	445 (87.3)		

Table 4-B.1: Summary of univariate association between antenatal MI and other risk factors at T1 and Apgar at 1 minute continues

Variables (N)	**Frequency (%)**	**Odds ratio (95% CI)**	***P* value**
Parity at intake (515)		1.156 (0.682 – 1.958)	0.590
Multigravida	319 (61.9)		
Primigravida	196 (38.1)		
Pregnancy intention (515)		1.245 (0.665 – 2.330)	0.494
No	111 (21.6)		
Yes	404 (78.4)	Yes	404 (78.4)
Smoking (508)		2.169 (0.148 – 1.543)	0.198
Yes	55 (10.9)		
No or quit	453 (89.1)		
Alcohol use (509)		1.368 (0.541 – 3.457)	0.558
Yes	35 (6.9)		
No or quit	474 (93.1)		
Drug use (510)		1.293 (0.273 – 6.118)	0.746
Yes	15 (2.9)		
No or quit	495 (97.1)	No or quit	495 (97.1)
Exercise (513)		1.021 (0.576 – 1.664)	0.717
Never or occasional	236 (46.1)		
Regular	277 (53.9)		

Table 4-B.2: Summary of univariate association between antenatal MI and other risk factors at T1 and Apgar at 5 minutes

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Mood instability (continuous) (516)	516	1.021 (0.919 – 1.027)	0.917
Marital status (517)		1.811 (0.393 – 8.348)	0.446
Without partner	42 (8.1)		
With partner	475 (91.9)		
Education (517)		1.604 (0.536 – 4.769)	0.398
< high school diploma	22 (4.2)		
≥ high school diploma	495 (95.8)		
Ethnicity (517)		1.674 (0.370 – 7.574)	0.598
Aboriginal	37 (7.2)		
Non-Aboriginal	480 (92.8)		
Family income (517)		1.201 (0.310 – 2.236)	0.263
≤$40,000	155 (29.9)		
>$40,000	362 (70.1)		
Age (517)		1.047 (0.231 - 4.751)	0.953
<25	84 (16.2)		
≥ 25	433 (83.8)		
Depression (515)		1.014 (0.901 - 1.140)	0.417
EPDS ≥12	64 (12.5)		
EPDS <12	451 (87.5)		
Depression as continuous variable (10 items) (515)		0.988 (0.877 – 1.113)	0.846
Depression as continuous variable (6 items) (515)		0.933 (0.825 – 1.196)	0.938
Depression as continuous variable (3 items) (515)		0.863 (0.634 – 1.174)	0.348
Anxiety (513)		2.375 (0.710 – 7.946)	0.160
EPDS subscale ≥6	51 (10.0)		
EPDS subscale <6	462 (90.0)		
Anxiety as continuous variable (513)		0.949 (0.733 – 1.227)	0.688
Stress level (514)		1.730 (0.582 – 5.147)	0.324
More (>2)	253 (49.3)		
Less (0-2)	261 (50.7)	Less (0-2)	261 (50.7)
Social support (512)		1.218 (0.187 – 4.173)	0.445
Less (0-1)	65 (12.7)		
More (≥2)	447 (87.3)		

Table 4-B.2: Summary of univariate association between antenatal MI and other risk factors at T1 and Apgar at 5 minutes continues

Parity at intake (517)		1.150 (0.402 – 3.290)	0.794
Multigravida	320 (61.9)		
Primigravida	197 (38.1)		
Pregnancy intention (517)		1.548 (0.343 – 6.990)	0.570
No	112 (21.6)		
Yes	405 (78.4)		
Smoking (516)		1.385 (0.171 – 3.449)	0.781
Yes	56 (10.9)		
No or quit	460 (89.1)		
Alcohol use (512)		1.520 (0.149 – 3.013)	0.576
Yes	35 (6.9)		
No or quit	477 (93.1)		
Drug use (513)		3.114 (0.373 – 26..034)	0.294
Yes	15 (2.9)		
No or quit	498 (97.1)		
Exercise (515)		1.700 (0.595 – 4.857)	0.334
Never or occasional	237 (46.1)		
Regular	278 (53.9)		

Table 4-B.3: Summary of univariate association between antenatal MI and other risk factors at T1 and birth weight

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Mood instability (continuous) (512)	512	1.004 (0.944 – 1.035)	0.973
Marital status (513)		1.293 (0.334 – 2.732)	0.574
Without partner	42 (8.1)		
With partner	471 (91.9)		
Education (513)		2.126 (0.849 – 5.328)	0.107
< high school diploma	22 (4.2)		
≥ high school diploma	491 (95.8)		
Ethnicity (513)		1.674 (0.370 – 7.574)	0.522
Aboriginal	37 (7.2)		
Non-Aboriginal	476 (92.8)		
Family income (513)		1.201 (0.310 – 2.236)	0.512
≤$40,000	153 (29.9)		
>$40,000	360 (70.1)		
Age (513)		1.206 (0.301 - 2.280)	0.220
<25	83 (16.2)		
≥ 25	430 (83.8)		
Depression (509)		1.020 (0.357 - 3.722)	0.307
EPDS ≥12	64 (12.5)		
EPDS <12	445 (87.5)		
Depression as continuous variable (10 items) (509)		1.000 (0.905 – 1.106)	0.966
Depression as continuous variable (6 items) (509)		0.979 (0.843 – 1.137)	0.783
Depression as continuous variable (3 items) (509)		1.064 (0.729 – 1.553)	0.747
Anxiety (508)		1.030 (0.291 – 3.647)	0.963
EPDS subscale ≥6	50 (9.8)		
EPDS subscale <6	458 (90.2)		
Anxiety as continuous variable (508)		1.057 (0.846 – 1.321)	0.627
Stress level (509)		1.594 (0.578 – 4.401)	0.068
More (>2)	251 (49.3)		
Less (0-2)	258 (50.7)		
Social support (512)		1.133 (0.322 – 3.995)	0.920
Less (0-1)	65 (12.7)		
More (≥2)	447 (87.3)		

Table 4-B.3: Summary of univariate association between antenatal MI and other risk factors at T1 and birth weight continues

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Parity at intake (513)		2.604 (1.045 – 6.491)	0.040
Multigravida	318 (61.9)		
Primigravida	195 (38.1)		
Pregnancy intention (513)		2.222 (0.863 – 5.721)	0.098
No	111 (21.6)		
Yes	402 (78.4)		
Smoking (510)		1.656 (0.466 – 5.890)	0.458
Yes	56 (10.9)		
No or quit	454 (89.1)		
Alcohol use (509)		1.449 (0.090 – 5.350)	0.701
Yes	35 (6.9)		
No or quit	474 (93.1)		
Drug use (507)		1.254 (0.598 – 11.314)	0.040
Yes	15 (2.9)		
No or quit	492 (97.1)		
Exercise (512)		2.700 (0.868 – 8.401)	0.125
Never or occasional	236 (46.1)		
Regular	276 (53.9)		

Table 4-B.4: Summary of univariate association between antenatal MI and other risk factors at T1 and birthweight for gestation age

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Mood instability (continuous) (512)	512	1.010 (0.947 – 1.012)	0.961
Marital status (512)		1.838 (0.728 – 4.638)	0.198
Without partner	42 (8.1)		
With partner	470 (91.9)		
Education (512)		1.513 (0.774 – 2.959)	0.226
< high school diploma	22 (4.2)		
≥ high school diploma	490 (95.8)		
Ethnicity (512)		1.469 (0.492 – 4.389)	0.491
Aboriginal	37 (7.2)		
Non-Aboriginal	475 (92.8)		
Family income (512)		1.201 (0.310 – 2.236)	0.332
≤$40,000	153 (29.9)		
>$40,000	359 (70.1)		
Age (512)		1.206 (0.301 - 2.280)	0.541
<25	83 (16.2)		
≥ 25	429 (83.8)		
Depression (509)		1.044 (0.977 - 1.116)	0.792
EPDS ≥12	64 (12.5)		
EPDS <12	445 (87.5)		
Depression as continuous variable (10 items) (509)		0.956 (0.896 – 1.020)	0.176
Depression as continuous variable (6 items) (509)		0.932 (0.845 – 1.027)	0.152
Depression as continuous variable (3 items) (509)		1.278 (0.950 – 1.719)	0.106
Anxiety (510)		1.701 (0.352 – 1.806)	0.588
EPDS subscale ≥6	52 (10.1)		
EPDS subscale <6	458 (89.9)		
Anxiety as continuous variable (510)		0.924 (0.795 – 1.075)	0.305
Stress level (509)		1.186 (0.634 – 2.218)	0.593
More (>2)	251 (49.3)		
Less (0-2)	258 (50.7)		
Social support (508)		2.141 (0.997 - 4.599)	0.079
Less (0-1)	65 (12.7)		
More (≥2)	443 (87.3)		

Table 4-B.4: Summary of univariate association between antenatal MI and other risk factors at T1 and birthweight for gestation age continues

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Parity at intake (512)		2.985 (1.579 – 5.644)	0.001
Multigravida	317 (61.9)		
Primigravida	195 (38.1)		
Pregnancy intention (512)		2.061 (1.047 – 4.057)	0.036
No	111 (21.6)		
Yes	401 (78.4)		
Smoking (510)		3.908 (1.815 - 8.412)	0.001
Yes	56 (10.9)		
No or quit	454 (89.1)		
Alcohol use (507)		1.517 (0.152 – 2.853)	0.546
Yes	35 (6.9)		
No or quit	572 (93.1)		
Drug use (508)		1.089 (0.089 – 2.030)	0.284
Yes	15 (2.9)		
No or quit	493 (97.1)		
Exercise (512)		1.116 (0.588 - 2.117)	0.645
Never or occasional	236 (46.1)		
Regular	276 (53.9)		

Table 4-B.5: Summary of univariate association antenatal MI and other risk factors at T1 and preterm birth

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Mood instability (continuous) (508)	508	1.014 (0.982 – 1.047)	0.909
Marital status (508)		1.440 (0.332 – 6.244)	0.626
Without partner	41 (8.1)		
With partner	467(91.9)		
Education (508)		2.247 (1.075 – 4.697)	0.031
< high school diploma	21 (4.2)		
≥ high school diploma	487 (95.8)		
Ethnicity (508)		1.674 (0.370 – 7.574)	0.561
Aboriginal	37 (7.2)		
Non-Aboriginal	471 (92.8)		
Family income (508)		1.201 (0.310 – 2.236)	0.969
≤$40,000	152 (29.9)		
>$40,000	356 (70.1)		
Age (508)		1.206 (0.301 - 2.280)	0.540
<25	82 (16.2)		
≥ 25	426 (83.8)		
Depression (501)		1.017 (0.940 - 1.100)	0.622
EPDS ≥12	63 (12.5)		
EPDS <12	438 (87.5)		
Depression as continuous variable (10 items) (501)		0.981 (0.908 – 1.060)	0.627
Depression as continuous variable (6 items) (501)		0.948 (0.846 – 1.062)	0.355
Depression as continuous variable (3 items) (501)		0.961 (0.739 – 1.250)	0.769
Anxiety (500)		1.311 (0.258 – 2.247)	0.625
EPDS subscale ≥6	51 (10.2)		
EPDS subscale <6	449 (89.8)		
Anxiety as continuous variable (500)		1.024 (0.857 – 1.222)	0.788
Stress level (506)		1.346 (0.358 – 1.539)	0.423
More (>2)	249 (49.3)		
Less (0-2)	257 (50.7)		
Social support (507)		1.493 (0.589 – 3.784)	0.381
Less (0-1)	64 (12.7)		
More (≥2)	443 (87.3)		

Table 4-B.5: Summary of univariate association antenatal MI and other risk factors at T1 and preterm birth continues

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Parity at intake (508)		1.351 (0.655 – 2.785)	0.415
Multigravida	314 (61.9)		
Primigravida	194 (38.1)		
Pregnancy intention (508)		1.643 (0.735 – 3.673)	0.226
No	110 (21.6)		
Yes	398 (78.4)		
Smoking (507)		1.318 (0.442 – 3.932)	0.627
Yes	55 (10.9)		
No or quit	452 (89.1)		
Alcohol use (505)		2.026 (0.667 – 6.159)	0.225
Yes	35 (6.9)		
No or quit	470 (93.1)		
Drug use (502)		5.935 (1.495 – 23.568)	0.011
Yes	15 (2.9)		
No or quit	487 (97.1)		
Exercise (508)		1.392 (0.340 – 1.513)	0.279
Never or occasional	234 (46.1)		
Regular	274 (53.9)		

Table 4-B.6: Summary of univariate association between antenatal MI and other risk factors at T2 and Apgar at 1 minute

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Mood instability (continuous) (513)	513	1.016 (0.988 – 1.045)	0.943
Marital status (515)		1.678 (0.733 – 3.845)	0.221
Without partner	42 (8.1)		
With partner	473 (91.9)		
Education (515)		1.013 (0.552 – 1.859)	0.967
< high school diploma	22 (4.2)		
≥ high school diploma	493 (95.8)		
Ethnicity (515)		1.594 (0.470 – 5.408)	0.454
Aboriginal	37 (7.2)		
Non-Aboriginal	478 (92.8)		
Family income (515)		1.347 (0.766 – 2.367)	0.301
≤$40,000	154 (29.9)		
>$40,000	361 (70.1)		
Age (515)		1.243 (0.564 - 2.738)	0.590
<25	83 (16.2)		
≥ 25	432 (83.8)		
Depression (509)		1.011 (0.948 - 1.078)	0.530
EPDS ≥12	55 (10.7)		
EPDS <12	454 (89.3)		
Depression as continuous variable (10 items) (509)		0.981 (0.923 – 1.044)	0.554
Depression as continuous variable (6 items) (509)		0.985 (0.896 – 1.083)	0.752
Depression as continuous variable (3 items) (509)		0.984 (0.816 – 1.187)	0.869
Anxiety (507)		3.344 (1.609 – 6.950)	0.001
EPDS subscale ≥6	44 (8.6)		
EPDS subscale <6	463 (91.4)		
Anxiety as continuous variable (507)		0.957 (0.833 – 1.099)	0.530
Stress level (505)		1.421 (0.842 – 2.399)	0.188
More (>2)	231 (45.7)		
Less (0-2)	274 (54.3)		
Social support (501)		1.175 (0.523 – 2.641)	0.695
Less (0-1)	60 (11.9)		
More (≥2)	441 (88.1)		

Table 4-B.6: Summary of univariate association between antenatal MI and other risk factors at T2 and Apgar at 1 minute continues

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Parity at intake (515)		1.156 (0.682 – 1.958)	0.590
Multigravida	319 (61.9)		
Primigravida	196 (38.1)		
Pregnancy intention (515)		1.245 (0.665 – 2.330)	0.494
No	111 (21.6)		
Yes	404 (78.4)		
Smoking (500)		1.497 (0.513 – 4.367)	0.460
Yes	53 (10.7)		
No or quit	447 (89.3)		
Alcohol use (505)		1.984 (0.621 – 6.344)	0.248
Yes	18 (3.6)		
No or quit	487 (96.4)		
Drug use (501)			
Yes	5 (1.0)*(Inadequate)		
No or quit	496 (99.0)		
Exercise (502)		1.048 (0.620 – 1.774)	0.862
Never or occasional	225 (44.9)		
Regular	277 (55.1)		

Table 4-B.7: Summary of univariate association between antenatal MI and other risk factors at T2 and Apgar at 5 minutes

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Mood instability (continuous) (512)	512	1.023 (0.974 – 1.023)	0.893
Marital status (517)		1.811 (0.393 – 8.348)	0.446
Without partner	42 (8.1)		
With partner	475 (91.9)		
Education (517)		1.604 (0.536 – 4.769)	0.398
< high school diploma	22 (4.2)		
≥ high school diploma	495 (95.8)		
Ethnicity (517)		1.674 (0.370 – 7.574)	0.598
Aboriginal	37 (7.2)		
Non-Aboriginal	480 (92.8)		
Family income (517)		1.201 (0.310 – 2.236)	0.263
≤$40,000	155 (29.9)		
>$40,000	362 (70.1)		
Age (517)		1.047 (0.231 - 4.751)	0.953
<25	84 (16.2)		
≥ 25	433 (83.8)		
Depression (508)		1.527 (0.331 – 7.050)	0.587
EPDS ≥12	54 (10.7)		
EPDS <12	454 (89.3)		
Depression as continuous variable (10 items) (508)		0.933 (0.832 – 1.045)	0.229
Depression as continuous variable (6 items) (508)		0.928 (0.779 – 1.106)	0.404
Depression as continuous variable (3 items) (508)		0.863 (0.634 – 1.174)	0.348
Anxiety (506)		4.103 (1.223 –13.764)	0.022
EPDS subscale ≥6	43 (8.5)		
EPDS subscale <6	463 (91.5)		
Anxiety as continuous variable (506)		0.837 (0.637 – 1.100)	0.202
Stress level (510)		1.167 (0.695 – 1.960)	0.735
More (>2)	235 (45.7)		
Less (0-2)	275 (54.3)		
Social support (508)		2.111 (0.574 – 7.764)	0.261
Less (0-1)	60 (11.9)		
More (≥2)	448 (88.1)		

Table 4-B.7: Summary of univariate association between antenatal MI and other risk factors at T2 and Apgar at 5 minutes continues

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Parity at intake (517)		1.150 (0.402 – 3.290)	0.794
Multigravida	320 (61.9)		
Primigravida	197 (38.1)		
Pregnancy intention (517)		1.548 (0.343 – 6.990)	0.570
No	112 (21.6)		
Yes	405 (78.4)		
Smoking (501)		1.200 (0.153 – 9.427)	0.863
Yes	54 (10.7)		
No or quit	447 (89.3)		
Alcohol use (502)		1.537 (0.550 – 5.081)	0.583
Yes	18 (3.6)		
No or quit	484 (96.4)		
Drug use (500)			
Yes	5(1.0)*(Inadequate)		
No or quit	495 (99.0)		
Exercise (503)		1.070 (0.365 – 3.315)	0.902
Never or occasional	226 (44.9)		
Regular	277 (55.1)		

Table 4-B.8: Summary of univariate association between antenatal MI and other risk factors at T2 and birth weight

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Mood instability (continuous) (502)	502	1.002 (0.951 – 1.057)	0.903
Marital status (513)		1.293 (0.334 – 2.732)	0.574
Without partner	42 (8.1)		
With partner	471 (91.9)		
Education (513)		2.126 (0.849 – 5.328)	0.107
< high school diploma	22 (4.2)		
≥ high school diploma	491 (95.8)		
Ethnicity (513)		1.674 (0.370 – 7.574)	0.522
Aboriginal	37 (7.2)		
Non-Aboriginal	476 (92.8)		
Family income (v)		1.201 (0.310 – 2.236)	0.512
≤$40,000	153 (29.9)		
>$40,000	360 (70.1)		
Age (513)		1.206 (0.301 - 2.280)	0.220
<25	83 (16.2)		
≥ 25	430 (83.8)		
Depression (507)		1.014 (0.903 - 1.139)	0.777
EPDS ≥12	54 (10.7)		
EPDS <12	453 (89.3)		
Depression as continuous variable (10 items) (507)		0.998 (0.889 – 1.120)	0.973
Depression as continuous variable (6 items) (507)		1.051 (0.866 – 1.275)	0.613
Depression as continuous variable (3 items) (507)		1.064 (0.729 – 1.553)	0.747
Anxiety (505)		2.977 (0.927 – 9.563)	0.067
EPDS subscale ≥6	43 (8.6)		
EPDS subscale <6	462 (91.4)		
Anxiety as continuous variable (509)		0.889 (0.695 – 1.139)	0.353
Stress level (505)		1.196 (0.448 – 3.195)	0.721
More (>2)	231 (45.7)		
Less (0-2)	274 (54.3)		
Social support (502)		1.010 (0.226 – 4.516)	0.990
Less (0-1)	60 (11.9)		
More (≥2)	442 (88.1)		

Table 4-B.8: Summary of univariate association between antenatal MI and other risk factors at T2 and birth weight continues

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Parity at intake (513)		2.604 (1.045 – 6.491)	0.040
Multigravida	318 (61.9)		
Primigravida	195 (38.1)		
Pregnancy intention (513)		2.222 (0.863 – 5.721)	0.098
No	111 (21.6)		
Yes	402 (78.4)		
Smoking (502)		1.277 (0.283 – 5.764)	0.750
Yes	54 (10.7)		
No or quit	448 (89.3)		
Alcohol use (504)		1.452 (0.184 – 11.487)	0.724
Yes	18 (3.6)		
No or quit	486 (96.4)		
Drug use (500)			
Yes	5 (1.0)* (inadequate)		
No or quit	495 (99.0)		
Exercise (505)		2.700 (0.868 – 8.401)	0.086
Never or occasional	227 (44.9)		
Regular	278 (55.1)		

Table 4-B.9: Summary of univariate association between antenatal MI and other risk factors at T2 and birth weight for gestational age

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Mood instability (continuous) (507)	507	1.009 (0.947 – 1.026)	0.935
Marital status (512)		1.838 (0.728 – 4.638)	0.198
Without partner	42 (8.1)		
With partner	470 (91.9)		
Education (512)		1.513 (0.774 – 2.959)	0.226
< high school diploma	22 (4.2)		
≥ high school diploma	490 (95.8)		
Ethnicity (512)		1.469 (0.492 – 4.389)	0.491
Aboriginal	37 (7.2)		
Non-Aboriginal	475 (92.8)		
Family income (512)		1.201 (0.310 – 2.236)	0.332
≤$40,000	153 (29.9)		
>$40,000	359 (70.1)		
Age (512)		1.206 (0.301 - 2.280)	0.541
<25	83 (16.2)		
≥ 25	429 (83.8)		
Depression (503)		1.326 (0.494 – 3.561)	0.576
EPDS ≥12	54 (10.7)		
EPDS <12	449 (89.3)		
Depression as continuous variable (10 items) (503)		1.017 (0.939 – 1.100)	0.683
Depression as continuous variable (6 items) (503)		1.062 (0.934 – 1.210)	0.352
Depression as continuous variable (3 items) (503)		1.201 (0.924 – 1.627)	0.213
Anxiety (504)		1.891 (0.741 – 4.824)	0.183
EPDS subscale ≥6	43 (8.5)		
EPDS subscale <6	461 (91.5)		
Anxiety as continuous variable (504)		0.974 (0.824 – 1.151)	0.755
Stress level (502)		2.212 (1.104 – 4.432)	0.025
More (>2)	229 (45.7)		
Less (0-2)	273 (54.3)		
Social support (503)		1.488 (0.593 – 3.376)	0.397
Less (0-1)	60 (11.9)		
More (≥2)	443 (88.1)		

Table 4-B.9: Summary of univariate association between antenatal MI and other risk factors at T2 and birth weight for gestational age continues

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Parity at intake (512)		2.985 (1.579 – 5.644)	0.001
Multigravida	317 (61.9)		
Primigravida	195 (38.1)		
Pregnancy intention (512)		2.061 (1.047 – 4.057)	0.036
No	111 (21.6)		
Yes	401 (78.4)		
Smoking (500)		3.643 (1.645 – 8.026)	0.001
Yes	54 (10.7)		
No or quit	446 (89.3)		
Alcohol use (501)		1.304 (0.290 – 5.864)	0.730
Yes	18 (3.6)		
No or quit	483 (96.4)		
Drug use (500)			
Yes	5 (1.0)* (inadequate)		
No or quit	395 (99.0)		
Exercise (502)		1.859 (0.918 – 3.766)	0.071
Never or occasional	225 (44.9)		
Regular	277 (55.1)		

Table 4-B.10: Summary of univariate association between antenatal MI and other risk factors at T2 and preterm birth

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Mood instability (continuous) (503)	503	1.014 (0.974 – 1.057)	0.948
Marital status (508)		1.440 (0.332 – 6.244)	0.626
Without partner	41 (8.1)		
With partner	467(91.9)		
Education (508)		2.247 (1.075 – 4.697)	0.031
< high school diploma	21 (4.2)		
≥ high school diploma	487 (95.8)		
Ethnicity (508)		1.674 (0.370 – 7.574)	0.561
Aboriginal	37 (7.2)		
Non-Aboriginal	471 (92.8)		
Family income (508)		1.201 (0.310 – 2.236)	0.969
≤$40,000	152 (29.9)		
>$40,000	356 (70.1)		
Age (508)		1.206 (0.301 - 2.280)	0.540
<25	82 (16.2)		
≥ 25	426 (83.8)		
Depression (501)		1.038 (0.953 - 1.134)	0.383
EPDS ≥12	54 (10.7)		
EPDS <12	447 (89.3)		
Depression as continuous variable (10 items) (501)		0.968 (0.888 – 1.056)	0.467
Depression as continuous variable (6 items) (501)		0.980 (0.854 – 1.124)	0.772
Depression as continuous variable (3 items) (501)		0.961 (0.739 – 1.250)	0.769
Anxiety (500)		1.659 (0.546 – 5.043)	0.372
EPDS subscale ≥6	43 (8.6)		
EPDS subscale <6	457 (91.4)		
Anxiety as continuous variable (500)		0.870 (0.714 – 1.061)	0.170
Stress level (501)		1.131 (0.520 – 2.461)	0.755
More (>2)	229 (45.7)		
Less (0-2)	272 (54.3)		
Social support (504)		1.354 (0.451 – 4.064)	0.589
Less (0-1)	60 (11.9)		
More (≥2)	444 (88.1)		

Table 4-B.10: Summary of univariate association between antenatal MI and other risk factors at T2 and preterm birth continues

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Parity at intake (508)		1.351 (0.655 – 2.785)	0.415
Multigravida	314 (61.9)		
Primigravida	194 (38.1)		
Pregnancy intention (508)		1.643 (0.735 – 3.673)	0.226
No	110 (21.6)		
Yes	398 (78.4)		
Smoking (501)		1.727 (0.570 – 5.230)	0.334
Yes	54 (10.7)		
No or quit	447 (89.3)		
Alcohol use (502)		1.879 (0.431 – 8.555)	0.415
Yes	18 (3.6)		
No or quit	484 (96.4)		
Drug use (500)			
Yes	5 (1.0)*(Inadequate)		
No or quit	495 (99.0)		
Exercise (505)		1.643 (0.723 – 3.734)	0.236
Never or occasional	227 (44.9)		
Regular	278 (55.1)		

Table 4-B.11: Summary of univariate association between antenatal MI and other risk factors during pregnancy and Apgar at 1 minute

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Mood instability (continuous) (508)	508	1.006 (0.977 – 1.037)	0.949
Marital status (515)		1.678 (0.733 – 3.845)	0.221
Without partner	42 (8.1)		
With partner	473 (91.9)		
Education (515)		1.013 (0.552 – 1.859)	0.967
< high school diploma	22 (4.2)		
≥ high school diploma	493 (95.8)		
Ethnicity (515)		1.594 (0.470 – 5.408)	0.454
Aboriginal	37 (7.2)		
Non-Aboriginal	478 (92.8)		
Family income (515)		1.347 (0.766 – 2.367)	0.301
≤$40,000	154 (29.9)		
>$40,000	361 (70.1)		
Age (515)		1.243 (0.564 - 2.738)	0.590
<25	83 (16.2)		
≥ 25	432 (83.8)		
Depression (510)		1.150 (0.357 - 20.722)	0.799
EPDS ≥12	70 (13.8)		
EPDS <12	440 (86.2)		
Anxiety (508)		2.875 (1.122 – 7.364)	0.028
EPDS subscale ≥6	48 (9.5)		
EPDS subscale <6	460 (90.5)		
Stress level (509)		1.280 (0.667 – 2.458)	0.458
More (>2)	389(76.4)		
Less (0-2)	120 (23.6)		
Social support (508)		1.303 (0.584 – 2.908)	0.462
Less (0-2)	90 (17.7)		
More (≥2)	418 (82.3)		
Parity at intake (515)		1.156 (0.682 – 1.958)	0.590
Multigravida	319 (61.9)		
Primigravida	196 (38.1)		
Pregnancy intention (515)		1.245 (0.665 – 2.330)	0.494
No	111 (21.6)		
Yes	404 (78.4)		

Table 4-B.11: Summary of univariate association between antenatal MI and other risk factors during pregnancy and Apgar at 1 minute continues

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Smoking (510)		1.613 (0.555 – 4.688)	0.479
Yes	63 (12.3)		
No or quit	447 (87.7)		
Alcohol use (507)		1.364 (0.604 – 3.082)	0.456
Yes	46 (9.0)		
No or quit	461 (91.0)		
Drug use (509)		1.159 (0.248 – 5.414)	0.851
Yes	18 (3.5)		
No or quit	491 (96.5)		
Exercise (512)		1.032 (0.613 – 1.737)	0.906
Never or occasional	218 (42.7)		
Regular	293 (57.3)		

Table 4-B.12: Summary of univariate association between antenatal MI and other risk factors during pregnancy and Apgar at 5 minutes

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Mood instability (continuous) (510)	510	1.003 (0.938 – 1.061)	0.937
Marital status (517)		1.811 (0.393 – 8.348)	0.446
Without partner	42 (8.1)		
With partner	475 (91.9)		
Education (517)		1.604 (0.536 – 4.769)	0.398
< high school diploma	22 (4.2)		
≥ high school diploma	495 (95.8)		
Ethnicity (517)		1.674 (0.370 – 7.574)	0.598
Aboriginal	37 (7.2)		
Non-Aboriginal	480 (92.8)		
Family income (517)		1.201 (0.310 – 2.236)	0.263
≤$40,000	155 (29.9)		
>$40,000	362 (70.1)		
Age (517)		1.047 (0.231 - 4.751)	0.953
<25	84 (16.2)		
≥ 25	433 (83.8)		
Depression (515)		1.847 (0.398 - 8.576)	0.433
EPDS ≥12	71 (13.8)		
EPDS <12	444 (86.2)		
Anxiety (514)		6.174 (1.569 – 24.293)	0.009
EPDS subscale ≥6	50 (9.7)		
EPDS subscale <6	464 (90.3)		
Stress level (514)		1.162 (0.318 – 4.246)	0.802
More (>2)	393 (76.4)		
Less (0-2)	121 (23.6)		
Social support (512)		1.007 (0.213 – 4.769)	0.993
Less (0-2)	91 (17.7)		
More (≥2)	421 (82.3)		
Parity at intake (517)		1.150 (0.402 – 3.290)	0.794
Multigravida	320 (61.9)		
Primigravida	197 (38.1)		
Pregnancy intention (517)		1.548 (0.343 – 6.990)	0.570
No	112 (21.6)		
Yes	405 (78.4)		

Table 4-B.12: Summary of univariate association between antenatal MI and other risk factors during pregnancy and Apgar at 5 minutes continues

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Smoking (516)		1.342 (0.172 – 10.475)	0.779
Yes	64 (12.3)		
No or quit	452 (87.7)		
Alcohol use (512)		1.209 (0.502 – 5.708)	0.998
Yes	46 (9.0)		
No or quit	466 (91.0)		
Drug use (513)		2.951 (0.354 – 24.591)	0.317
Yes	18 (3.5)		
No or quit	495 (96.5)		
Exercise (515)		1.465 (0.493 – 4.357)	0.492
Never or occasional	220 (42.7)		
Regular	295 (57.3)		

Table 4-B.13: Summary of univariate association between antenatal MI and other risk factors during pregnancy and birth weight

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Mood instability (continuous) (513)	513	1.007 (0.923 – 1.042)	0.921
Marital status (513)		1.293 (0.334 – 2.732)	0.574
Without partner	42 (8.1)		
With partner	471 (91.9)		
Education (513)		2.126 (0.849 – 5.328)	0.107
< high school diploma	22 (4.2)		
≥ high school diploma	491 (95.8)		
Ethnicity (513)		1.674 (0.370 – 7.574)	0.522
Aboriginal	37 (7.2)		
Non-Aboriginal	476 (92.8)		
Family income (513)		1.201 (0.310 – 2.236)	0.512
≤$40,000	153 (29.9)		
>$40,000	360 (70.1)		
Age (513)		1.206 (0.301 - 2.280)	0.220
<25	83 (16.2)		
≥ 25	430 (83.8)		
Depression (509)		1.519 (0.405 - 6.743)	0.689
EPDS ≥12	70 (13.8)		
EPDS <12	439 (86.2)		
Anxiety (508)		2.406 (0.318 – 8.172)	0.263
EPDS subscale ≥6	48 (9.5)		
EPDS subscale <6	460 (90.5)		
Stress level (509)		1.914 (0.680 – 5.383)	0.219
More (>2)	389 (76.4)		
Less (0-2)	120 (23.6)		
Social support (512)		1.432 (0.401 – 3.312)	0.319
Less (0-2)	91 (17.7)		
More (≥2)	421 (82.3)		
Parity at intake (513)		2.604 (1.045 – 6.491)	0.040
Multigravida	318 (61.9)		
Primigravida	195 (38.1)		
Pregnancy intention (513)		2.222 (0.863 – 5.721)	0.098
No	111 (21.6)		
Yes	402 (78.4)		

Table 4-B.13: Summary of univariate association between antenatal MI and other risk factors during pregnancy and birth weight continues

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Smoking (510)		1.610 (0.455 – 5.694)	0.460
Yes	63 (12.3)		
No or quit	447 (87.7)		
Alcohol use (509)		1.403 (0.399 – 6.350)	0.876
Yes	46 (9.0)		
No or quit	463 (91.0)		
Drug use (507)		1.573 (0.586 – 7.821)	0.587
Yes	18 (3.5)		
No or quit	489 (96.5)		
Exercise (512)		2.620 (1.027 – 6.683)	0.044
Never or occasional	219 (42.7)		
Regular	293 (57.3)		

Table 4-B.14: Summary of univariate association between antenatal MI and other risk factors during pregnancy and birth weight for gestational age

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Mood instability (continuous) (512)	512	1.011 (0.947 – 1.023)	0.975
Marital status (512)		1.838 (0.728 – 4.638)	0.198
Without partner	42 (8.1)		
With partner	470 (91.9)		
Education (512)		1.513 (0.774 – 2.959)	0.226
< high school diploma	22 (4.2)		
≥ high school diploma	490 (95.8)		
Ethnicity (512)		1.469 (0.492 – 4.389)	0.491
Aboriginal	37 (7.2)		
Non-Aboriginal	475 (92.8)		
Family income (512)		1.201 (0.310 – 2.236)	0.332
≤$40,000	153 (29.9)		
>$40,000	359 (70.1)		
Age (512)		1.206 (0.301 - 2.280)	0.541
<25	83 (16.2)		
≥ 25	429 (83.8)		
Depression (509)		1.180 (0.389 - 3.494)	0.764
EPDS ≥12	70 (13.8)		
EPDS <12	439 (86.2)		
Anxiety (510)		2.673 (0.950 – 7.524)	0.063
EPDS subscale ≥6	48 (9.4)		
EPDS subscale <6	462 (90.6)		
Stress level (509)		1.483 (0.741 – 2.969)	0.266
More (>2)	389 (76.4)		
Less (0-2)	120 (23.6)		
Social support (508)		1.122 (0.443 – 2.846)	0.808
Less (0-2)	90 (17.7)		
More (≥2)	418 (82.3)		
Parity at intake (512)		2.985 (1.579 – 5.644)	0.001
Multigravida	317 (61.9)		
Primigravida	195 (38.1)		
Pregnancy intention (512)		2.061 (1.047 – 4.057)	0.036
No	111 (21.6)		
Yes	401 (78.4)		

Table 4-B.14: Summary of univariate association between antenatal MI and other risk factors during pregnancy and birth weight for gestational age continues

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Smoking (510)		3.648 (1.708 – 7.794)	0.001
Yes	63 (12.3)		
No or quit	447 (87.7)		
Alcohol use (508)		1.393 (0.414 – 4.693)	0.593
Yes	46 (9.0)		
No or quit	462 (91.0)		
Drug use (508)		2.088 (0.442 – 9.853)	0.352
Yes	18 (3.5)		
No or quit	490 (96.5)		
Exercise (512)		1.370 (0.737 – 2.545)	0.320
Never or occasional	219 (42.7)		
Regular	293 (57.3)		

Table 4-B.15: Summary of univariate association between antenatal MI and other risk factors during pregnancy and preterm birth

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Mood instability (continuous) (508)	508	1.019 (0.978 – 1.062)	0.971
Marital status (508)		1.440 (0.332 – 6.244)	0.626
Without partner	41 (8.1)		
With partner	467(91.9)		
Education (508)		2.247 (1.075 – 4.697)	0.031
< high school diploma	21 (4.2)		
≥ high school diploma	487 (95.8)		
Ethnicity (508)		1.674 (0.370 – 7.574)	0.561
Aboriginal	37 (7.2)		
Non-Aboriginal	471 (92.8)		
Family income (508)		1.201 (0.310 – 2.236)	0.969
≤$40,000	152 (29.9)		
>$40,000	356 (70.1)		
Age (508)		1.206 (0.301 - 2.280)	0.540
<25	82 (16.2)		
≥ 25	426 (83.8)		
Depression (502)		2.913 (0.629 - 5.819)	0.253
EPDS ≥12	69 (13.8)		
EPDS <12	433 (86.2)		
Anxiety (501)		2.201 (0.617 – 7.851)	0.224
EPDS subscale ≥6	47 (9.4)		
EPDS subscale <6	454 (90.6)		
Stress level (506)		1.403 (0.594 – 3.318)	0.441
More (>2)	387 (76.4)		
Less (0-2)	119 (23.6)		
Social support (507)		1.084 (0.359 – 3.275)	0.886
Less (0-2)	90 (17.7)		
More (≥2)	417 (82.3)		
Parity at intake (508)		1.351 (0.655 – 2.785)	0.415
Multigravida	314 (61.9)		
Primigravida	194 (38.1)		
Pregnancy intention (508)		1.643 (0.735 – 3.673)	0.226
No	110 (21.6)		
Yes	398 (78.4)		

Table 4-B.15: Summary of univariate association between antenatal MI and other risk factors during pregnancy and preterm birth continues

Variables (N)	Frequency (%)	Odds ratio (95% CI)	*p* value
Smoking (507)		1.737 (0.637 – 4.733)	0.281
Yes	62 (12.3)		
No or quit	445 (87.7)		
Alcohol use (505)		1.446 (0.484 – 4.319)	0.509
Yes	45 (9.0)		
No or quit	460 (91.0)		
Drug use (502)		5.933 (1.512 – 23.288)	0.011
Yes	18 (3.5)		
No or quit	484 (96.5)		
Exercise (508)		1.193 (0.582 – 2.466)	0.630
Never or occasional	217 (42.7)		
Regular	291 (57.3)		

Transition Note 3

In Chapter 4, perinatal MI and depression at T1, T2, and during pregnancy did not show significant effects on neonatal outcomes (1-minute Apgar, 5-minute Apgar, BW, BW for gestational age, and PTB). However, antenatal anxiety, and several other measures were associated with an increased risk of LBW, and low 1 and 5-minute Apgar scores, and SGA. Elevated anxiety symptoms at T2 was found to be significantly associated with LBW, and low 1-minute and 5-minute Apgar, and a higher level of stress at T2 was identified to increase the risk of having a baby with SGA, and non-smoking during pregnancy was recognized as a protective factor for SGA. Finally, being primiparous was significantly associated with LBW and SGA in the current study.

In addition to investigating the relationship between perinatal MI and its risk factors, its association with PPD, and its effects on neonatal outcomes, another important issue that requires much-needed attention is determining which instruments are effective in measuring perinatal MI. In the selected articles in our systematic review, a majority of measures in assessing perinatal MI had been either one single question about mood fluctuation or VAS measures for perinatal MI, of which the psychometric properties were not examined. The ALS-18, an instrument for measuring affective lability, has been widely used in general and clinical populations, and its psychometric properties have been investigated in non-clinical and clinical samples with various psychiatric disorders. However, its psychometric properties have not been examined in perinatal women. Therefore, in Chapter 5, a fourth manuscript is presented to explore factor structure and psychometric properties of ALS-18 in pregnant and postpartum women with mood symptoms.

Chapter 5: Manuscript Four

Factor Structure and Psychometric Properties of ALS-18 in Pregnant and Postpartum Women

Abstract

Objective: Investigating the dimensions of affective lability may help to explain possible etiology and outcomes for mental disorders. The Affective Lability Scale-18 (ALS-18) is a widely utilized measure of labile affect, and its psychometric properties have been studied in non-clinical and clinical populations. However, the psychometric properties have not previously been examined in pregnant and postpartum women despite the fact that affective lability is a prominent feature in pregnant and postpartum women. In this study, we used a sample comprised of pregnant and postpartum women with various mood symptoms to explore the psychometric properties of the ALS-18. **Method**: 113 pregnant and postpartum women with mood symptoms participated in this study. Confirmatory factor analyses (CFA) were performed to compare the fit of alternative models. **Results**: The three-factor structure of the ALS-18 presented a nearly acceptable model fit and a high internal consistency, while the six-factor model of the ALS-18 displayed a good model fit and an acceptable to high internal consistency. **Conclusions**: Our findings from pregnant and postpartum women with mood symptoms showed evidence for six underlying factors of ALS-18, and a close to acceptable model fit of three-factor ALS-18. ALS-18 can be used as an instrument of measuring affective lability in perinatal women. Further research is needed to test the three-factor substructure of the ALS-18 against alternative factor models in a larger sample of pregnant and postpartum women.

Keywords: Perinatal women; affect lability; measurement; Affective Lability Scale; psychometric properties

5.1 Introduction

Fluctuations in mood are a known feature of women during their reproductive years, particularly during pregnancy and postpartum (Bowen, A, Bowen, Balbuena, & Muhajarine, 2012; Mitchell, 2017; Toffol, Heikinheimo, & Partonen, 2015). The transition to motherhood is one of the most challenging times in a woman's life. Expectant and new mothers undergo many physical and biological changes, but also face remarkable emotional, behavioural, and cognitive adjustments to adapt to the demands of motherhood during postpartum and infant care (Goyal, Gay, & Lee, 2007). In addition, the transition to motherhood represents a time of greater vulnerability to develop mood related disorders and disturbances, including perinatal depression (Kessler et al., 2003), and postpartum blues and mood swings (Steiner, 1998).

Studies have found that perinatal women often experience the highest irritable, euphoric, and depressed mood in early pregnancy and again at the time of delivery (Cunningham et al., 2010; Steiner, Dunn, & Born, 2003). In the early postpartum, emotional lability is prominent (Hapgood, Elkind, & Wright, 1988; Nott, Franklin, Armitage, & Gelder, 1976), and some women experience both elation and dysphoria at the same time, with mood changes occurring several times a day (Hapgood et al., 1988). This phenomenon is thought to be triggered by the large hormonal changes during this period (Buttner, O'Hara, & Watson, 2012; Cunningham et al., 2010; Fooladi, 2006).

Bowen, A. et al. (2012) investigated MI in a group of pregnant women into early postpartum (n=45) compared to a control group of normally menstruating non-pregnant women (n=31). Mood instability was measured by using mood diaries with visual analogue scales (VAS) for depressed, irritable, anxious, and euphoric moods for both groups in the morning and evening. Depressive symptoms were assessed by using the Edinburgh Postnatal Depression Scale

(EPDS) (Cox, Holden, & Sagovsky, 1987). The perinatal women completed three separate mood diaries (each for 7 days) after three interviews (16 weeks and 30 weeks of pregnancy, and 4 weeks postpartum, while the control group completed the mood diaries for two consecutive menstrual cycles (eight weeks). The findings suggest that perinatal women were more likely to experience depressed, irritable, anxious, and euphoric mood fluctuation in comparison to the controls, indicating increased moodiness in perinatal women. Furthermore, the findings except depression still held when depressed perinatal women were removed from the comparison. Contrary to most of the existing literature which predominantly focuses on depressive mood in perinatal period, the authors suggested that mood variation is a prominent feature in perinatal women.

Affective lability can be defined as the rapid fluctuation in the valence and intensity of an individual's emotional experiences (Anestis et al., 2009). Labile affect constitutes a primary feature of several different diagnostic conceptions in psychopathology, including borderline personality disorder, bipolar disorder, and intermittent explosive disorder (Harvey, 1989). Affective lability has been associated with a variety of psychiatric disorders. To explain the relationship between depression and emotional regulation, Barlow (2000) suggested that depression involves dysregulation, not only of cognitions, but also of emotions and behaviours. Berking, Wirtz, Svaldi, and Hofmann (2014) reported that deficits of emotion regulation at baseline negatively predicted depressive symptom severity five years later while controlling for baseline levels of depressive symptoms.

Identifying the number of dimensions that underlie a particular mental disorder may help elucidate its etiology and outcomes (Cosgrove et al., 2011). For example, the Hospital Anxiety and Depression Scale consists of two subscales (Snaith, 2003). According to a Norwegian cohort

study, while insomnia is a characteristic of people in a depressed state, insomnia is a trait marker for developing future anxiety (Neckelmann, Mykletun, & Dahl, 2007). This suggests that sleep intervention therapies may be important for preventing anxiety disorders. A finding such as this might not have been possible if anxiety and depression were conceptualized as a single dimension.

Developing a health measurement scale may follow the steps suggested by Streiner, Norman and Cairney (2015): 1) Creating a scale questionnaire, the items of a scale can be devised from focus groups, research, or expert opinion. 2) Content validation, which includes ensuring each item falls into at least one content area represented by the objective, and each objective should be represented by at least one question. 3) Scaling responses which may take many forms, ranging from dichotomous to continuous, such as visual analogue scales, Likert scales, or adjective scales. 4) Selecting the items, the criteria for selection include being comprehensible to the target audience, unambiguous, and checking internal consistency of the scale using coefficient α. 5) Testing reliability, a primary way to reflect the amount of error, both random and systematic, inherent in any measurement. The Pearson correlation, Cohen's Kappa or the intraclass correlation are often used to examine the reliability of a scale. 6) Testing validity. Validity test includes three main types: content validity, criterion validity, and construct validity. Content validity refers that a scale represents all facets of a given construct. Criterion validity tests a measure related to an outcome including concurrent validity and predictive validity. Concurrent validation is often used when an existing measure will be replaced by a simpler, or less invasive one, while predictive validity is used when we develop instruments that allow us to get answers earlier than current instruments allow. Construct validity examines whether an instrument measures the intended construct. Constructs are abstractions that are

developed by researchers in order to conceptualize the latent variable, which are variables that are not directly observed but are rather inferred (Borsboom, Mellenbergh, & Van Heerden, 2003). Construct validity includes convergent validity and discriminant validity. Convergent validity refers how well a test agrees with other previously validated tests that measure the same construct while discriminant (divergent) validity is the extent to which a test measures what it is supposed to and not theoretically unrelated construct (Streiner et al., 2015).

Various instruments have been used in measuring affect lability labeled by different combinations of the words: affective, mood, emotion, instability, lability, swings and dysregulation (Marwaha et al., 2014). A total of 24 distinct measures were identified in a systematic review, and they have been utilized in a variety of mental disorders (Marwaha et al., 2014). For assessing rapid shift of affect, the Affective Lability Scale (ALS-54) (Harvey, Greenberg, & Serper, 1989), the Affective Lability Scale Short Form (ALS-18) (Oliver & Simons, 2004), Mood Lability Scale (MLS) (Akiskal et al., 1995), the Ecological Momentary Assessment (EMA) (Stone & Shiffman, 1994), and the Impulsivity/Emotional Lability Scale (I/ELS) (Erhardt, Epstein, Conners, Parker, & Sitarenios, 1999) were used in different studies (Marwaha et al., 2014). The ALS-54 was utilized in bipolar disorder, borderline personality disorder, depression, personality disorder, and post-traumatic stress disorder; the ALS-18 was used in depression, personality disorder, bipolar disorder, and attention deficit hyperactivity disorder (ADHD); the MLS was used in bipolar disorder and depression; the EMA was used in borderline personality disorder and depression; the I/ELS was used in ADHD (Marwaha et al., 2014). Marwaha et al. (2014) found that the ALS-54 has good internal consistency and is the most frequently used instrument in the area of affect lability studies.

Harvey, Greenberg and Serper (1989) developed a 54-item Affective Lability Scale (ALS-54) to measure the tendency for rapid shifts in emotion. The ALS-54 focused on depression, anxiety, elation, and anger as well as the proneness to shift between depression and elation, and between depression and anxiety. Items were created to capture subjective experience, physiological perceptions, and behaviours using the six subscales (Harvey et al., 1989). In a series of four studies with a total of 577 undergraduate students in the US (two independent samples: 218 undergraduate students were enrolled at term one, and 359 undergraduate students participated in term two). Harvey et al. (1989) created the items utilizing expert opinion and previous research evidence, and the items were individually rated by the subjects with a four-point (0-3) Likert scale to descript the self-reported level of affect. An item was rejected when it was uncorrelated with its own scale (r <0.20), or that was more strongly correlated with another scale than with its own scale. In the first study, Cronbach α coefficient was conducted on two independent samples to test internal consistency of the scale, and the six subscales' Cronbach α were all > 0.80, except anger (Cronbach α > 0.70). The second study examined stability of the scales by re-testing the scales at a one-month interval, and found that retest reliability of the scales was acceptable. In the third study, discriminant validity was provided for the ALS-54 by examining the association between ALS-54 scores and a measure of affect intensity (the Affect Intensity Measures (AIM) (Larsen & Diener, 1987)), and it suggests that affective lability utilizing the ALS-54 scale and affect intensity are independent dimensions (Harvey et al., 1989). The final study examined the relationship between labile affect and current depression using the Beck Depression Inventory (BDI) as measuring depressive symptoms (Beck, Steer, & Brown, 1996), and found that the ALS-54 depression subscale was negatively correlated with BDI (r = -0.53). The authors explained that the result might be due to the low

level of depressive symptoms of this sample of undergraduates, and also might be because scores on the ALS-54 are not a straightforward function of individuals who experience depressive symptoms also revealing themselves to the labile affect (Harvey et al., 1989).

To make this self-reported instrument less time consuming, Oliver and Simons (2004) developed an 18-item short form (ALS-18) of the 54-item ALS through a series of three studies with 592 first and second-year undergraduate students in Austria. The ALS-18 item version is rested on a three-factor model of affective lability (anxiety/depression, depression/elation, and anger), and each factor includes at least two items from each of the original six subscale version. ALS-18 has been found to be highly correlated with the original version of ALS-54 (r =.94) (Look, Flory, Harvey, & Siever, 2010).

The first study presented the development of the ALS-18 by conducting an exploratory factor analysis (EFA) of the ALS-54, evaluation of congruence between the ALS-54 and ALS-18, and relationship between the ALS-18 and other measures including affect intensity, depression, and impulsivity (Oliver & Simons, 2004). Selection of items was conducted through an iterative elimination process. At first, selecting items from ALS-54 was based on their contribution to the internal consistency of each subscale, meaning each scale maintaining a scale $\alpha > 0.75$, which resulted in a 33-items scale. Another factor analysis on the 33-item scale was conducted, and the selection was based on maintaining a scale $\alpha > 0.80$, which resulted in 18 items. A convergent validity was conducted by correlating the ALS-18 total score with ALS-54 scale total score as well as with other related measures (affect intensity, impulsivity, depression), and found that ALS-18 was highly correlated with ALS-54 ($r = 0.94$), as well as highly similar relationship between the two ALS scales (ALS-54 and ALS-18) and their correlations with the affect intensity, impulsivity, and depression scales (Oliver & Simons, 2004). In the second study,

a CFA of ALS-18 with an independent sample was conducted. The three-factor model demonstrated a good fit, however, a six-factor structure of ALS-18 provided a better fit. Finally, study 3 conducted test-retest reliability of ALS-18 by administrating the ALS-18 questionnaire to the participants twice with one month apart, and found that the correlation from T1 to T2 ranged from 0.55 to 0.73 for the sample overall, and paired t-test of mean scores did not differ from T1 to T2 for all scales (Oliver & Simons, 2004).

The ALS-18 was tested in nonclinical samples of undergraduate students, and its psychometric properties have been studied in clinical populations: personality disorders (Look et al., 2010), bipolar disorder (Aas et al., 2015), and ADHD (Weibel et al., 2017). However, there is no known research on affective lability in perinatal women, and specifically, what instruments are most accurate for measuring affective lability in this population. Our study is the only study known to us that examines the psychometric properties of the ALS-18 among pregnant and postpartum women with mood symptoms.

5.2 Research Hypothesis

The ALS-18 would be a valid instrument for measuring affective lability in pregnant and postpartum women with various mood symptoms.

5.3 Methods

5.3.1 Participants and procedure

One hundred and thirteen pregnant and postpartum women with mood symptoms participated in this study. Women were recruited from a local maternal mental health program (MMHP) funded by the Saskatchewan Health Research Foundation (Grant# 1834). The MMHP was developed to improve the mental health of pregnant and postpartum women in the Saskatoon Health Region (SHR), Saskatchewan, Canada (Bowen, A., Baetz, McKee, & Klebaum, 2009).

The women came to the MMHP via referral by their family physician or nurse practitioners, then were contacted by a MMHP nurse who triaged them to appropriate services – counseling, facilitated educational and peer support group or psychiatric consultation. Only women who received psychiatric consultation were invited to participate the study. Women were mailed arrangements for their initial appointment with psychiatric consultation along with the intake questionnaire. Then they either brought the completed intake questionnaire to the MMHP when they attended their first appointment or completed it while waiting to be seen by a health care provider.

After receiving a detailed description of the study, women gave their written informed consent. Women were informed that refusal to participate in the study did not change the care and services provided to them by the program. Ethics approval was obtained from the Behavioural Research Ethics Board of the University of Saskatchewan and operational approval of the SHR.

5.3.2 Measures

Assessment of affective lability. The Affect Lability Scale-18 (Oliver & Simon, 2004) was used to measure perinatal affective instability. The scale is an 18-item, self-reported measure, and each item is rated on a 4-point (0-3) scale ranging from "very uncharacteristic of me" to "very characteristic of me" and with a maximum score of 54. Factor analysis has confirmed good fit for three dimensions in the ALS-18: anxiety/depression shift (5 items), depression/elation shift (8 items), and anger (5 items) (Oliver & Simons, 2004). The ALS-18 showed good psychometric properties in patients with personality disorders, bipolar disorder, and ADHD (Aas et al., 2015; Look et al., 2010; Weibel et al., 2017).

Assessment of other mood symptoms. Depression symptoms were measured using the Edinburgh Postnatal Depression Scale (EPDS) (Cox et al., 1987). A cut-off score of 12 (≥12 depressed; <12 indicates not depressed) was used in this present study to determine depression status (Husain et al., 2014; Murray & Cox, 1990; Smith, Eryigit-Madzwamuse, & Barnes, 2013). The 7-item Generalized Anxiety Disorder Scale (GAD-7) (Spitzer, Kroenke, Williams, & Löwe, 2006) was utilized to determine participating women's anxiety status. A cut-off point of 10 or greater was identified with optimized sensitivity (89%) and specificity (82%), and was used in the current study (Spitzer et al., 2006). The validation studies of GAD-7 indicated that the GAD-7 is a useful instrument for assessing GAD in pregnant and postpartum women (Simpson, Glazer, Michalski, Steiner, & Frey, 2014; Zhong et al., 2015). The Mood Disorder Questionnaire (MDQ) (Hirschfeld et al., 2000) was administrated to evaluate participating women's hypomania, or bipolar symptoms. A cut-off score of 7 or more yielded good sensitivity (0.73) and very good specificity (0.90), and was used in this study (Hirschfeld et al., 2000). The MDQ was validated in pregnant and postpartum women with bipolar disorder or major depressive disorder, and studies suggested that the MDQ is a useful screening instrument for bipolar disorder in perinatal women (Chessick & Dimidjian, 2010; Sharma & Xie, 2011).

5.3.3 Data Analysis

Descriptive statistics of the data included frequencies and percentage of variables together with means and standard deviations. For the validation process, we analyzed the psychometric properties of the ALS-18 in perinatal women including construct validity, and internal validity. To measure internal reliability consistency, Cronbach α for ALS-18 factor scores were computed. Statistical analysis were conducted using Stata version 15. Results were considered to provide evidence of significance if p-values <0.05 (α level of 5%).

5.3.3.1 Construct validity

To examine the psychometric properties of ALS-18, Confirmatory factor analyses (CFA) was performed to evaluate the factor structure within a measurement model and to determine how well the measurement model fits to its data. Structural equation modeling (SEM) was used to analyze the structural relationship between measured variables and latent constructs in models (Oliver & Simons, 2004; Ullman & Bentler, 2003). Structural equation modeling is a largely confirmatory, rather than exploratory, to determine whether a certain model is valid, and CFA is one of the major applications of SEM (Ullman & Bentler, 2003). Therefore, CFA was used to compare the goodness-of-fit between the following models: one-factor, three-factors (anxiety/depression, depression/elation, and anger), and six-factors (anxiety, anxiety/depression, depression, elation, depression/elation, and anger) (Oliver & Simons, 2004).

5.3.3.2 Model fit diagnostic

Goodness-of-fit was assessed in all models using normed chi-square (χ^2/degrees of freedom, *df*), Tucker Lewis Index (TLI), Comparative Fit Index (CFI), and root mean square error of approximation (RMSEA). To reduce the impact of sample size on the model chi-Square, a good fit is suggested when the χ^2/df is 2 or lower (Tabachnick & Fidell, 2007). RMSEA values up to 0.05 indicate a close fit, values between 0.05 and 0.08 indicate an acceptable fit, values between 0.08 and 0.10 indicate a mediocre fit, and those greater than 0.10 indicate a poor fit (Wijenberg, Stapert, Köhler, & Bol, 2016). CFI and TLI values > 0.95 indicate a good fit and values between 0.90 and 0.95 indicate an acceptable fit (Wijenberg et al., 2016). However, in sample sizes < 500, it is recommended that less stringent goodness of fit indices be used when evaluating factor structure (CFI and TLI values ≥ 0.90 and RMSEA < 1.0 are acceptable) (Weston & Gore Jr, 2006).

The Chi-Square value is used to evaluate overall model fit by assessing the degree of discrepancy between the observed sample covariance matrix and fitted covariance matrix (Hu & Bentler, 1999). To reduce the impact of sample size on the model, normed chi-square (χ^2/df) was used to assess goodness-of-fit. A good fit is suggested when the χ^2/df is 2 or lower (Tabachnick & Fidell, 2007). The RMSEA was used to assess how well the model with chosen parameter estimates would fit the sample covariance matrix (Byrne, 2013). Comparative Fit Index and TLI evaluate the model by comparing the chi-square value of the null model to the chi-square of the model while CFI takes into account of sample size, and TLI adjusts for degree of freedom (Byrne, 2013).

Confirmatory factor analyses (CFA) models were evaluated using the maximum likelihood estimate with Satorra-Bentler scaled chi square statistic for non-normally distributed data to provide an improved estimate of the fit of a model (Satorra & Bentler, 2001). We compared models using the Akaike Information Criteria (AIC) and the Bayesian Information Criteria (BIC), in which lower values indicate better fit (Levy & Hancock, 2007). The difference between the two models was calculated as ΔAIC and ΔBIC. Values of ΔAIC or ΔBIC equal to or greater than 10 indicate overwhelming support for the lower AIC and BIC model (Burnham & Anderson, 2004). In a factor analysis, a sample size in a range of 100 to 200 is considered acceptable (MacCallum, Widaman, Zhang, & Hong, 1999).

5.3.3.3 Internal structure validity.

Item internal consistency (IIC) was investigated by correlating each item with its related factor using Pearson correlation coefficient, and an acceptable level of IIC is recommended at least 0.40 of correlation (Carey & Seibert, 1993). Item discriminant validity (IDV) was examined

by determining whether the correlation between items and their presenting factor is better than the correlation between items and other factors (Campbell & Fiske, 1998).

Factor loadings represent the relationship of each item or variable to the underlying latent factor (Thompson, 2004). There is no consensus on whether an item or a variable belongs to a factor based on factor loading in general. Traditionally, in the social and behavioural sciences, factor loading of 0.30 as the minimum has been used (Merenda, 1997). Hair, Anderson, Tatham and Black (1998) suggested that factor loadings ≥ 0.30 satisfy the minimum threshold, factor loadings ≥ 0.40 are good, and factor loadings of 0.50 or greater are considered practically significant. For each factor, internal consistency was assessed by Cronbach's α coefficient. To confirm consistency, a coefficient of at least 0.7 was expected for each dimension (Cronbach, 1951).

5.3.3.4 Relationship between affective lability and current depression, anxiety, and hypomania or bipolar symptoms

To investigate if labile affects as identified on the ALS-18 were determined by current depressive, anxiety, hypomania or bipolar symptoms, we examined the correlations between lability of affect and level of current depressive (EPDS score), anxiety (GAD-7 score), and hypomanic mood or bipolar symptoms (MDQ score). Since some ALS-18 factors are also highly correlated with each other (Appendix 5-A Table 5-A.1), a regression design was used to control for the interrelationships. Factor scores of three factor ALS-18, and factor scores of six factor ALS-18 were entered into a stepwise regression, predicting EPDS, GAD-7, and MDQ scores respectively (Harvey, Greenberg, & Serper, 1989). Finally, the correlations between ALS-18 scores and EPDS, GAD-7, and MDQ scores were examined by using the Pearson correlation.

5.4 Results

Variables of interest for accuracy of skewness, Kurtosis, missing values, and outliers were examined. Univariate outliers were not detected. Items of ALS-18 were skewed, with significant ($p<0.001$) Kolmogorov-Smirnov and Shapiro-Wilk normality tests, indicating the variable had non-normal distribution. Satorra-Bentler scaled chi square statistic for non-normally distributed data was used to provide an improved estimate of the fit of a model (Satorra & Bentler, 2001). There is no missing data in ALS-18.

5.4.1 Sample characteristics

The 113 pregnant and postpartum women participants had a mean age of 29.17 (*SD* = 4.91; range = 19-42 years old), 49.5% (n = 56) were pregnant (mean = 23.46 weeks, *SD* = 8.80), and 50.5% (n = 57) were postpartum (mean = 19.41 weeks, *SD* = 12.8). Over 90% of women lived with a partner (n = 99), nearly 80% of women had post-secondary education (n = 90), and 81.4% of participating women were Caucasian (n= 92), while 13 (11.5%) Aboriginal women were involved in this study.

All the participating women exhibited mood symptoms to varying degree. The mean of EPDS score was 16.02 (*SD* = 5.50), and 75.9% of women (n = 88) screened positive for depression (EPDS $\geq$ 12). The GAD-7 mean score = 8.88 (*SD* = 5.83), with anxiety symptoms presented in 37.9% of women (n = 44) (GAD-7 $\geq$ 10); the mean score of MDQ = 4.71 (*SD* = 3.31), and 23.3% of women (n = 27) reported hypomania symptoms (MDQ $\geq$ 7); finally, the mean score of ALS-18 = 23.39 (*SD* = 12.25). Additionally, 97.7% of women who experienced anxiety and 88.89% of women who presented hypomania symptoms also concurrently showed depressive symptoms.

5.4.2 Construct validity

A CFA was utilized to compare the goodness-of-fit of the three competing models. The factor loading for three-factor model and six-factor model are presented in Appendix 5-B Table 5-B.1 and 5-B.2. The results of CFA for each model are displayed in Table 5.1. The upper part of Table 5.1 presents the goodness-of-fit parameters for each model. For one-factor model, goodness-of-fit information suggested a poor fit to the data, $\chi^2/df = 3.65$, $p<0.001$; TLI = 0.649; CFI = 0.641; RMSEA = 0.153; $p<0.001$. Model fit indices for the three-factor model indicated a near acceptable fit to the data, $\chi^2/df = 2.10$, $p<0.001$; TLI = 0.855; CFI = 0.875; RMSEA = 0.098; $p<0.001$. The six-factor model showed a good fit to the data, $\chi^2/df = 1.82$, $p<0.001$; TLI = 0.891; CFI = 0.914; RMSEA = 0.085; $p<0.001$. The lower part of Table 5.1 displays the results for the comparisons between models. The three-factor model structured by anxiety/depression, depression/elation, and anger was superior to the one-factor model (ΔAIC = 228.655 and ΔBIC = 220.473). The six-factor model structured by anxiety, anxiety/depression, depression, elation, depression/elation, and anger was also superior to the one-factor model (ΔAIC = 265.291 and ΔBIC = 224.380), and better than the three-factor model (ΔAIC = 36.636 and ΔBIC = 3.907) (Table 5.1).

All items presented standardized loadings of > 0.50 for all three models except item 1 in one-factor model (0.33) (Appendix 5-B Table 5-B.1-2, Appendix 5-D Figures 5-D.1-3).

Table 5.1: Confirmatory factorial analysis of three different models of ALS-18

	Models of ALS-18 Dimensions		
Maximum Likelihood with Satorra-Bentler scaled chi-square	One-factor (All 18 items)	Three- factors (Anxiety/Depression, Depression/Elation, and Anger)	Six-factors (Anxiety, Anxiety/Depression, Depression, Elation, Depression/Elation, and Anger)
χ^2	492.166	276.543	218.916
Degrees of freedom (*df*)	135	132	120
χ^2/df	3.65	2.10	1.82
AIC	5104.017	4875.362	4838.726
BIC	5251.296	5030.823	5026.916
CFI	0.691	0.875	0.914
TLI	0.649	0.855	0.891
RMSEA	0.153	0.098	0.085
Comparisons	ΔAIC [a]	ΔBIC [a]	
1F vs. 3F	228.655	220.473	3-factor model better than 1-factor model
1F vs. 6F	265.291	224.380	6-factor model better than 1-factor model
3F vs. 6F	36.636	3.907	6-factor model better than 3-factor model

Note: 1F = one-factor model; 3F = three-factor model; 6F = six-factor model; AIC = Akaike Information Criteria; BIC = Bayesian Information Criteria; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = root mean square error of approximation.
[a]ΔAIC and ΔBIC were calculated as the difference between a candidate model and the best (i.e., lowest AIC and BIC model). Values equal to or greater than 10 for ΔAIC or ΔBIC indicate overwhelming support for the lower AIC and BIC models (Burnham & Anderson, 2004).

5.4.3 Internal structure validity

The IIC was adequate for the three and six factors of ALS-18 as each item attained above the standard threshold value of 0.40 (Appendix 5-C Table 5-C.1-2). The IDV was adequate: the correlation of items with their contributive factor was higher than items with the other factors (Appendix 5-C Table 5-C.1-2). The Cronbach α for factor anxiety/depression was 0.811, factor depression/elation was 0.893, and factor anger was 0.912, indicating high internal consistency for all three factors model. The Cronbach α for factor anxiety was 0.796, factor anxiety/depression was 0.775, factor depression was 0.796, factor Elation was 0.713, and factor

depression/elation was 0.820, and factor anger was 0.912, indicating acceptable or high internal consistency for all six factors model. The overall internal consistency reliability was satisfactory, and removing any item did not increase the Cronbach's α coefficient.

5.4.4 Relationship between labile affect and current depression, anxiety, and hypomania or bipolar symptoms

The means and standard deviation for EPDS, GAD-7, and MDQ scores, as well as correlations between the factors of ALS-18 scores and EPDS, GAD-7, and MDQ, are presented in Table 5.2 and 5.3. The results of the correlations between ALS-18 and EPDS, GAD-7, and MDQ showed that ALS-18 was weakly correlated with EPDS and GAD-7 (r = 0.33, 0.34 respectively), and moderately correlated with MDQ (r = 0.65) (Appendix 5-A Table 5-A.1).

Table 5.2: Correlations between ALS-18 three factor scores and EPDS, GAD-7, and MDQ scores

	Mean	SD	Correlation with EPDS	Mean	SD	Correlation with GAD-7	Mean	SD	Correlation with MDQ
A/D	8.00	3.59	0.46*	8.00	3.57	0.46*	8.02	3.57	0.09
D/E	9.41	6.15	-0.14	9.40	6.16	0.02	9.32	6.20	0.39*
Anger	6.06	4.77	0.04	6.05	4.72	-0.04	5.95	4.79	0.25*
EPDS (N = 111)	16.02	5.5							
GAD-7 (N = 112)				8.88	5.83				
MDQ (N = 105)							4.71	3.31	

Note: * $p < 0.05$. A/D: Anxiety/Depression, D/E: Depression/Elation

Table 5.3: Correlations between ALS-18 six factor scores and EPDS, GAD-7, and MDQ scores

	Mean	SD	Correlation with EPDS	Mean	SD	Correlation with GAD-7	Mean	SD	Correlation with MDQ
Anxiety	4.38	2.48	0.24*	4.40	2.46	0.43*	4.38	2.47	-0.22*
A/D	3.62	1.61	0.39*	3.60	1.62	0.19	3.64	1.61	0.11
Depression	5.38	3.13	0.13	5.34	3.15	0.08	5.31	3.17	-0.02
Elation	1.86	1.78	-0.48*	1.89	1.77	0.04	1.87	1.77	0.27*
D/E	2.16	1.99	0.32*	2.17	1.99	0.11	2.14	2.00	0.32*
Anger	6.06	4.77	0.05	6.05	4.72	0.03	5.95	4.79	0.35*
EPDS (N = 111)	16.02	5.5							
GAD-7 (N = 112)				8.88	5.83				
MDQ (N = 105)							4.71	3.31	

Note: * $p < 0.05$. A/D: Anxiety/Depression, D/E: Depression/Elation

In regards to ALS-18 three factor model, correlations between ALS-18 factors scores and EPDS score were calculated and the overall regression was significant, $F(1, 109) = 29.81$, $p < 0.0001$. All correlations were positive, except factor depression/elation. Only factor anxiety/depression predicted EPDS score that accounted for 20.8% of variance (adjusted R^2) in EPDS score, with the standardized regression coefficient = 0.46. Regression coefficients of depression and anger factors were nonsignificant. For the correlations between ALS-18 factors scores and GAD-7 score, the overall regression was significant, $F(1, 110) = 30.03$, $p < 0.0001$. Only factor anxiety/depression predicted GAD-7 score that accounted for 20.7% of variance (adjusted R^2) in GAD-7 score, with the standardized regression coefficient = 0.46. Regression coefficients of rest of factors were nonsignificant. Finally, for the correlations between ALS-18 factors scores and MDQ score, the overall regression was significant, $F(1, 102) = 13.67$, $p < 0.0001$. Factors anger, and depression/elation predicted MDQ score that accounted for 45.2% of variance (adjusted R^2) in MDQ score, with the standardized regression coefficient = 0.39, and 0.25 respectively. Regression coefficient of anxiety/depression factors was nonsignificant.

For the six factor ALS-18 model, in regards to correlations between ALS-18 factors scores and EPDS score, the overall regression was significant, $F(4, 106) = 13.40$, $p < 0.0001$. The relationships were positive, except factor elation. Factors anxiety/depression, anxiety, elation, and depression/elation predicted EPDS score that accounted for 31.1% of variance (adjusted R^2) in EPDS score, with the standardized regression coefficient = 0.39, 0.24, -0.48, and 0.32 respectively. Regression coefficients of depression and anger factors were nonsignificant. For the correlations between ALS-18 factors scores and GAD-7 score, the overall regression was significant, $F(1, 110) = 25.58$, $p < 0.0001$. Only factor anxiety predicted GAD-7 score that accounted for 18.1% of variance (adjusted R^2) in GAD-7 score, with the standardized regression

coefficient = 0.43. Regression coefficients of rest of factors were nonsignificant. Finally, for the correlations between ALS-18 factors scores and MDQ score, the overall regression was significant, $F(4, 100) = 26.71$, $p < 0.0001$. Factors anger, depression/elation, anxiety, and elation predicted MDQ score that accounted for 49.7% of variance (adjusted R^2) in MDQ score, with the standardized regression coefficient = 0.35, 32, -0.22, and 0.27 respectively. Regression coefficients of depression, and anxiety/depression factors were nonsignificant.

5.5 Discussion

The study evaluated the psychometric properties of the ALS-18 in a group of pregnant and postpartum women with various mood symptoms. The aim was to determine whether ALS-18 could serve as an efficient measure of affective lability in pregnant and postpartum women with mood symptoms. Our study demonstrated both the three-factor model and six-factor model provided better fit beyond a single factor model as an ALS-18 measure. The three-factor model demonstrated a close to acceptable fit while the six-factor model, where ALS-18 items were assigned to their original ALS scale, indicated a better fit over the three-factor model, which replicated findings from the original ALS-18 study by Oliver and Simons (2004). Similarly, the current study also reproduced the similar findings from Oliver and Simons that the alpha estimates for the six-factor model were somewhat lower than those for the three-factor model. Oliver and Simons suggested considering the trade-offs between increased scale specificity and weaker scale reliability while doing research. In Oliver and Simons' study (2004), both the three-factor model and six-factor model showed good fit in undergraduate students, although the six-factor model produced a better fit. In the current study, the internal consistency reliability for each of three dimensions of ALS-18 displayed to be high (Cronbach's $\alpha > 0.8$ for all), and for

each of six dimensions of ALS-18 showed to be from acceptable to high (Cronbach's α from 0.713 to 0.912). The IIC and IDV were satisfactory for both models.

We found that the level of depressive symptoms (EPDS score) is significantly correlated with shift between anxiety and depression of affective lability in both ALS-18 three factor and six factor models. The findings are in agreement with the aspect that the EPDS is a bi-dimensional instrument that measures both depression and anxiety (Bowen, A., Bowen, Maslany, & Muhajarine, 2008; Ross, Evans, Sellers, & Romach, 2003). In addition, it may partially explain the high comorbidity of anxiety and depression that presented in the form of shift between them. However, depressive symptoms (EPDS score) was not significantly associated with depression factor in ALS-18 six factor models, which may indicate that depression factor of ALS is not a straightforward function of women who experience depression, and also report labile affect (Harvey, 1989).

The level of anxiety (GAD-7 score) was significantly correlated with shift between anxiety and depression of affective lability in ALS-18 three factor model, but the correlation was not significant in ALS-18 six factor model. However, level of anxiety (GAD-7 score) was significantly correlated with anxiety factor in ALS-18 six factor model. The findings may be due to that the factor anxiety/depression in three factor ALS-18 combines items of anxiety factor and anxiety/depression factor of six factor ALS-18 model. The results suggest that six factor ALS-18 model captures symptoms of affective lability in perinatal women more accurately, which is in agreement with our CFA model fit results. Additionally, GAD-7 has not been found to be a bi-dimensional measurement that assesses both anxiety and depression.

The level of hypomania symptoms or bipolar symptoms (MDQ score) was significantly correlated with shift between depression and elation, and anger of affective lability in ALS-18

three factor model, and with shift between depression and elation, elation, and anger of labile affect in ALS-18 six factor model, which is consistent with the fact that MDQ has been used to detect hypomania symptoms, and bipolar disorder in community and clinical samples (Hirschfeld, Cass, Holt, & Carlson, 2005; Vieta et al., 2007). In terms of the correlation between MDQ and anger factor of ALS-18, factor analysis of the MDQ identified a two-factor structure in samples with mood disorders: elevated mood overactivity factor, and irritable behaviour factor (Castelo et al., 2010; Lin et al., 2011), but MDQ has not been indicated for detecting anger. Future studies could further investigate the relationship between MDQ and ALS-18.

The findings suggest that most labile affects as identified on the ALS-18 were determined by current depressive, anxiety, hypomania or bipolar symptoms, which has an important implication on clinical practice. For example, when perinatal women's moods are evaluated, clinicians tend to assess diagnosable symptoms, such as anxiety, depressive, or bipolar symptoms based on women's self-report. However, the results of the current study showed that perinatal women's affects were depicted in a labile fashion. Thus assessment tools that only measure single diagnosable disorder may not be able to capture all aspects of perinatal women's affects, and shift between affects.

5.6 Limitations

There are some limitations of the current study. First, our sample size was relatively small (n = 113), although some suggested that 100-200 sample size is enough for factor analysis (MacCallum et al., 1999). Others indicate that at least 10 observations for each item in the instrument being used is necessary (Bernstein & Nunnally, 1994). Second, due to our relatively smaller sample size, the current study did not conduct a cross-validation test to evaluate our model outside of the sample, which limited generalization of our results. Third, the measure of

affective lability relied on participants' subjective report and retrospective recall. Retrospective recall can be influenced by cognitive processes used to reconstruct past events (Schwartz & Rapkin, 2004). Individuals are more likely to recall or report the experiences that seem more personally relevant, and are more likely to recall memory that is congruent rather than incongruent with their current feelings (Fredrickson, 2000). Additionally, affective lability holds a temporal property since affect state can change from moment to moment, which is unlikely to be recalled accurately, such as which day and what hour during the day it occurred (Fredrickson, 2000). Ecological momentary assessment (EMA) showed the ability to capture immediate experience without relying on recall by utilizing diaries (Trull et al., 2008) or more recently by using smartphone (Faurholt-Jepsen et al., 2015). Future research on affective lability in perinatal women using EMA would capture the labile affect more accurately.

5.7 Conclusion

We found that the ALS-18 can be an effective instrument of measuring affective lability in perinatal women with various mood symptoms, and six-factor ALS-18 demonstrates better psychometric properties than the three-factor ALS-18. The current study also showed that ALS-18 scores were higher in women who experienced anxiety, and elevated mood, in addition, almost all women who experienced anxiety and a very high percentage of women who presented hypomania symptoms also concurrently showed depressive symptoms, suggesting affective lability is a prominent feature of in perinatal women who experience anxiety, depressive, and hypomania symptoms. Therefore, in order to evaluate perinatal women's mood symptoms in a more comprehensive way, affective lability assessment using ALS-18 should be utilized in routine screening in perinatal care.

5.8 References

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5.9 Appendix 5-A: Table of correlations across scales and factors of ALS-18

Table 5-A.1: Correlations across scales (EPDS, GAD7, and MDQ) and factors of ALS-18

Scales and factors	ALS-18	EPDS	GAD	MDQ	A/D_3 *(r)*	D/E_3) *(r)*	Anger_3 *(r)*	Anxiety_6 *(r)*	A/D_6 *(r)*	Depression_6 *(r)*	Elation_6 *(r)*	D/E_6 *(r)*
ALS-18	1.00											
EPDS	0.33****	1.00										
GAD	0.34****	0.51****	1.00									
MDQ	0.65****	0.18	0.15	1.00								
A/D_3	0.77**	0.45**	0.46**	0.45**	1.00							
D/E_3	0.92**	0.23	0.28**	0.63**	0.60**	1.00						
Anger	0.84**	0.22**	0.18	0.61**	0.47**	0.66**	1.00					
Anxiety_6	0.66**	0.38**	0.43**	0.22	0.92**	0.52**	0.35****	1.00				
A/D_6	0.69**	0.42**	0.35**	0.43**	0.80**	0.54**	0.49****	0.51****	1.00			
Depression_6	0.82**	0.15	0.21	0.52**	0.46**	0.92**	0.60****	0.38****	0.44****	1.00		
Elation_6	0.80**	0.14	0.26	0.57**	0.60**	0.84**	0.54****	0.54****	0.53****	0.65****	1.00	
D/E_6	0.85**	0.37**	0.30**	0.60**	0.61**	0.89**	0.60****	0.55****	0.51****	0.71**	0.71**	1.00

Note: 2-tailed Pearson Correlation: * $p < 0.05$, ** $p < 0.01$. A/D: Anxiety/Depression, D/E: Depression/Elation

5.10 Appendix 5-B: Tables of factor loading for ALS-18

Table 5-B.1: Factor loading for the three-factor ALS-18 (n = 113)

Items	Standardized	Standard error
Anxiety/Depression		
1.At times I feel just as realized as everyone else and then within minutes I become so nervous that I feel light-headed and dizzy	0.54	(0.062)
3. One minute I can be feeling OK and then the next minute I'm tense, jittery, and nervous	0.81	(0.053)
5. Many times I feel very nervous and tense and then suddenly feel very sad and down	0.75	(0.052)
6. Sometimes I go from feeling extremely anxious about something to feeling very down about it	0.54	(0.064)
7. I shift back and forth from feeling perfectly calm to feeling uptight and nervous	0.79	(0.0511)
Depression/Elation		
2. There are times when I have very little energy and then soon afterwards I have the same energy level as most people	0.64	(0.066)
10. Sometimes I can think clearly and concentrate well one minute and then the next minute I have a great deal of difficulty concentrating and thinking clearly	0.66	(0.069)
12. I switch back and forth between being extremely energetic and having so little energy that it's a huge effort just to get where I'm going	0.78	(0.077)
13. There are times when I feel absolutely wonderful about myself but soon afterwards I often feel that I am just about the same as everyone else	0.68	(0.064)
15. I shift back and forth between being very unproductive and being just as productive as everyone else	0.71	(0.045)
16. Sometimes I feel extremely energetic one minute and then the next minute I might have so little energy that I can barely do a thing	0.83	(0.058)
17. There are times when I have more energy than usual and more than most people and then soon afterwards I have about the same energy level as everyone else	0.72	(0.070)
18. At times I feel that I'm doing everything at a slow pace but then soon afterwards I feel that I'm no more slowed down than anyone else	0.66	(0.046)
Anger		
4. I frequently switch from being able to control my temper very well to not being able to control it very well at all	0.86	(0.046)
8. There are times when I feel perfectly calm one minute and then the next minute the least little thing makes me furious	0.86	(0.043)
9. Frequently, I will be feeling OK but then I suddenly get so mad that I could hit something	0.87	(0.044)
11. There are times when I am so mad that I can barely stop yelling and other times shortly afterwards when I wouldn't think of yelling at all	0.81	(0.048)
14. There are times when I'm so mad that my heart starts pounding and/or I start shaking and then shortly afterwards I feel quite relaxed	0.72	(0.063)

Table 5-B.2: Factor loading for the six-factor ALS-18 (n = 113)

Items	Standardized	Standard error
Anxiety		
1.At times I feel just as realized as everyone else and then within minutes I become so nervous that I feel light-headed and dizzy	0.59	(0.063)
3. One minute I can be feeling OK and then the next minute I'm tense, jittery, and nervous	0.88	(0.057)
7. I shift back and forth from feeling perfectly calm to feeling uptight and nervous	0.82	(0.055)
Anxiety/Depression		
5. Many times I feel very nervous and tense and then suddenly feel very sad and down	0.97	(0.104)
6. Sometimes I go from feeling extremely anxious about something to feeling very down about it	0.65	(0.075)
Depression		
2. There are times when I have very little energy and then soon afterwards I have the same energy level as most people	0.63	(0.067)
10. Sometimes I can think clearly and concentrate well one minute and then the next minute I have a great deal of difficulty concentrating and thinking clearly	0.70	(0.075)
15. I shift back and forth between being very unproductive and being just as productive as everyone else	0.76	(0.056)
18. At times I feel that I'm doing everything at a slow pace but then soon afterwards I feel that I'm no more slowed down than anyone else	0.72	(0.048)
Elation		
13. There are times when I feel absolutely wonderful about myself but soon afterwards I often feel that I am just about the same as everyone else	0.74	(0.087)
17. There are times when I have more energy than usual and more than most people and then soon afterwards I have about the same energy level as everyone else	0.76	(0.079)
Depression/Elation		
12. I switch back and forth between being extremely energetic and having so little energy that it's a huge effort just to get where I'm going	0.81	(0.084)
16. Sometimes I feel extremely energetic one minute and then the next minute I might have so little energy that I can barely do a thing	0.86	(0.064)
Anger		
4. I frequently switch from being able to control my temper very well to not being able to control it very well at all	0.86	(0.044)
8. There are times when I feel perfectly calm one minute and then the next minute the least little thing makes me furious	0.86	(0.045)
9. Frequently, I will be feeling OK but then I suddenly get so mad that I could hit something	0.87	(0.043)
11. There are times when I am so mad that I can barely stop yelling and other times shortly afterwards when I wouldn't think of yelling at all	0.81	(0.048)
14. There are times when I'm so mad that my heart starts pounding and/or I start shaking and then shortly afterwards I feel quite relaxed	0.71	(0.070)

5.11 Appendix 5-C: Tables of item correlation for ALS-18 factors

Table 5-C.1: Item correlation for ALS-18 three factor model (Pearson correlation coefficients)

Item	Anxiety/Depression *(r)*	Depression/Elation *(r)*	Anger *(r)*
Anxiety/Depression			
1.At times I feel just as realized as everyone else and then within minutes I become so nervous that I feel light-headed and dizzy	**0.67****	0.31**	0.13*
3. One minute I can be feeling OK and then the next minute I'm tense, jittery, and nervous	**0.85****	0.46**	0.32**
5. Many times I feel very nervous and tense and then suddenly feel very sad and down	**0.80****	0.56**	0.48**
6. Sometimes I go from feeling extremely anxious about something to feeling very down about it	**0.65****	0.42**	0.37**
7. I shift back and forth from feeling perfectly calm to feeling uptight and nervous	**0.81****	0.50**	0.45**
Depression/Elation			
2. There are times when I have very little energy and then soon afterwards I have the same energy level as most people	0.35**	**0.71****	0.33**
10. Sometimes I can think clearly and concentrate well one minute and then the next minute I have a great deal of difficulty concentrating and thinking clearly	0.39**	**0.72****	0.53**
12. I switch back and forth between being extremely energetic and having so little energy that it's a huge effort just to get where I'm going	0.57**	**0.79****	0.49**
13. There are times when I feel absolutely wonderful about myself but soon afterwards I often feel that I am just about the same as everyone else	0.53**	**0.73****	0.40**
15. I shift back and forth between being very unproductive and being just as productive as everyone else	0.41**	**0.74****	0.53**
16. Sometimes I feel extremely energetic one minute and then the next minute I might have so little energy that I can barely do a thing	0.54**	**0.83****	0.52**
17. There are times when I have more energy than usual and more than most people and then soon afterwards I have about the same energy level as everyone else	0.48**	**0.75****	0.50**
18. At times I feel that I'm doing everything at a slow pace but then soon afterwards I feel that I'm no more slowed down than anyone else	0.27**	**0.74****	0.39**

Note: 2-tailed Pearson Correlation: * $p < 0.05$, ** $p < 0.01$

Table 5-C.1: Item correlation for ALS-18 three factor model (Pearson correlation coefficients) continues

Item	Anxiety/Depression *(r)*	Depression/Elation *(r)*	Anger *(r)*
Anger			
4. I frequently switch from being able to control my temper very well to not being able to control it very well at all	0.38**	0.51**	**0.88****
8. There are times when I feel perfectly calm one minute and then the next minute the least little thing makes me furious	0.41**	0.51**	**0.88****
9. Frequently, I will be feeling OK but then I suddenly get so mad that I could hit something	0.44**	0.55**	**0.90****
11. There are times when I am so mad that I can barely stop yelling and other times shortly afterwards when I wouldn't think of yelling at all	0.31*	0.38**	**0.86****
14. There are times when I'm so mad that my heart starts pounding and/or I start shaking and then shortly afterwards I feel quite relaxed	0.45**	0.60**	**0.78****

Note: 2-tailed Pearson Correlation: * $p < 0.05$, ** $p < 0.01$

Table 5-C.2: Item correlation for ALS-18 six factor model (Pearson correlation coefficients)

Items	Anxiety *(r)*	Anxiety/Depression *(r)*	Depression *(r)*	Elation *(r)*	Depression/Elation *(r)*	Anger *(r)*
Anxiety						
1.At times I feel just as realized as everyone else and then within minutes I become so nervous that I feel light-headed and dizzy	0.79**	0.28**	0.17	0.33**	0.40**	0.13
3. One minute I can be feeling OK and then the next minute I'm tense, jittery, and nervous	0.88**	0.52**	0.36**	0.43**	0.46**	0.32**
7. I shift back and forth from feeling perfectly calm to feeling uptight and nervous	0.86**	0.47**	0.39**	0.47**	0.50**	0.45**
Anxiety/Depression						
5. Many times I feel very nervous and tense and then suddenly feel very sad and down	0.56**	0.91**	0.49**	0.50**	0.52**	0.49**
6. Sometimes I go from feeling extremely anxious about something to feeling very down about it	0.34**	0.90**	0.32**	0.42**	0.39**	0.37**
Depression						
2. There are times when I have very little energy and then soon afterwards I have the same energy level as most people	0.34**	0.25v	0.73**	0.54**	0.55**	0.33**
10. Sometimes I can think clearly and concentrate well one minute and then the next minute I have a great deal of difficulty concentrating and thinking clearly	0.31**	0.39v	0.79**	0.45**	0.56**	0.53**
15. I shift back and forth between being very unproductive and being just as productive as everyone else	0.30**	0.45**	0.80**	0.47**	0.60**	0.54**
18. At times I feel that I'm doing everything at a slow pace but then soon afterwards I feel that I'm no more slowed down than anyone else	0.19**	0.30**	0.82**	0.51**	0.51**	0.39**

Note: 2-tailed Pearson Correlation: * $p < 0.05$, ** $p < 0.01$

Table 5-C.2: Item correlation for ALS-18 six factors (Pearson correlation coefficients) continues

Items	Anxiety *(r)*	Anxiety/Depression *(r)*	Depression *(r)*	Elation *(r)*	Depression/Elation *(r)*	Anger *(r)*
Elation						
13. There are times when I feel absolutely wonderful about myself but soon afterwards I often feel that I am just about the same as everyone else	0.43**	0.50**	0.54**	0.89**	0.61**	0.40**
17. There are times when I have more energy than usual and more than most people and then soon afterwards I have about the same energy level as everyone else	0.42**	0.40**	0.59**	0.87**	0.61**	0.50**
Depression/Elation						
12. I switch back and forth between being extremely energetic and having so little energy that it's a huge effort just to get where I'm going	0.51**	0.81**	0.61**	0.64**	0.92**	0.49**
16. Sometimes I feel extremely energetic one minute and then the next minute I might have so little energy that I can barely do a thing	0.48**	0.86**	0.69**	0.64**	0.92**	0.51**
Anger						
4. I frequently switch from being able to control my temper very well to not being able to control it very well at all	0.30**	0.38**	0.54**	0.34**	0.43**	0.88**
8. There are times when I feel perfectly calm one minute and then the next minute the least little thing makes me furious	0.31**	0.42**	0.51**	0.38**	0.44**	0.88**
9. Frequently, I will be feeling OK but then I suddenly get so mad that I could hit something	0.29**	0.51**	0.50**	0.43**	0.51**	0.90**
11. There are times when I am so mad that I can barely stop yelling and other times shortly afterwards when I wouldn't think of yelling at all	0.27**	0.27**	0.43**	0.40**	0.47**	0.86**
14. There are times when I'm so mad that my heart starts pounding and/or I start shaking and then shortly afterwards I feel quite relaxed	0.35**	0.45**	0.49**	0.64**	0.52**	0.78**

Note: 2-tailed Pearson Correlation: * $p < 0.05$, ** $p < 0.01$

5.12 Appendix 5-D: Figures of CFA of ALS-18 factor models

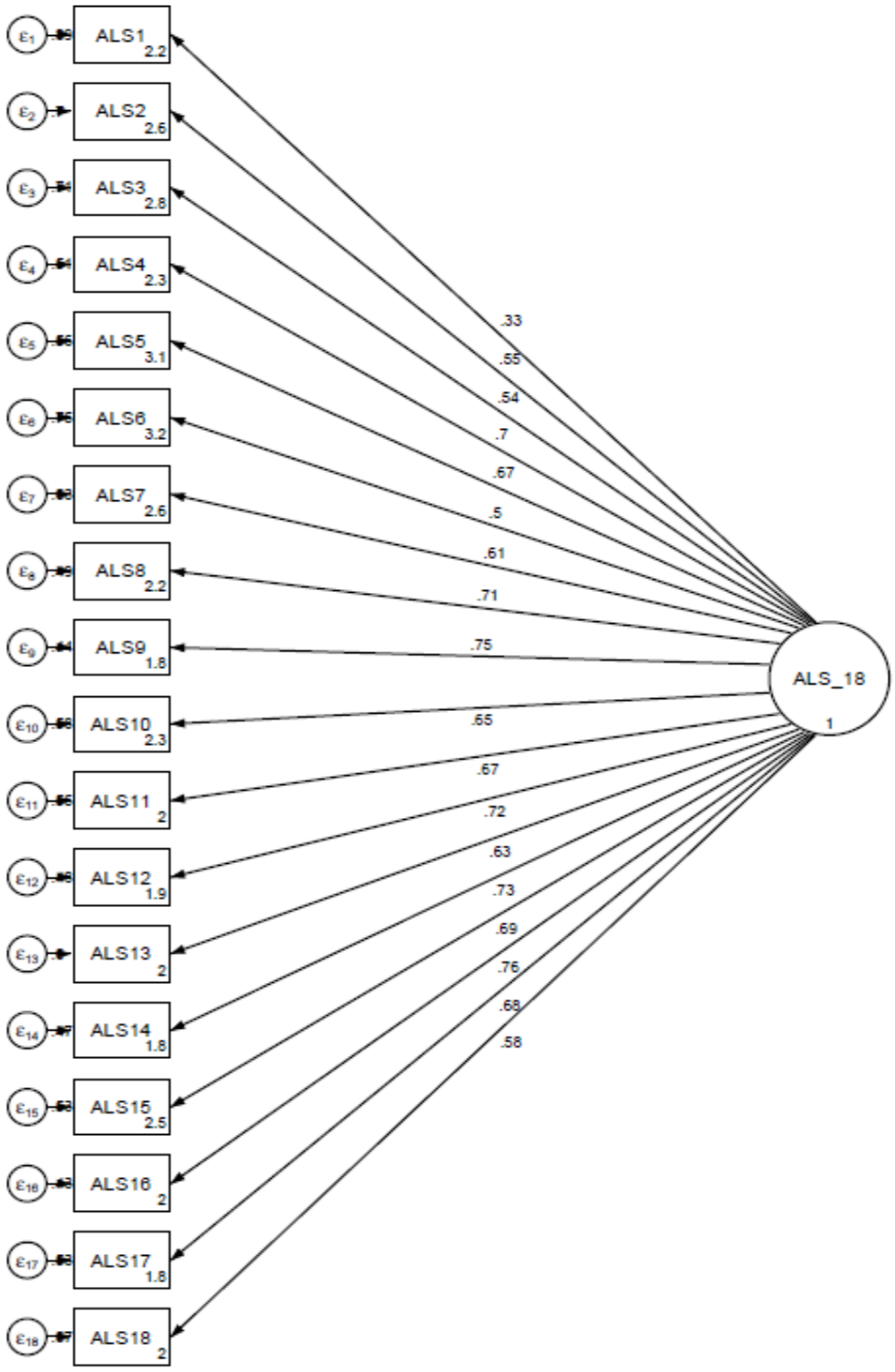

Figure 5-D.1. CFA of the one-factor model of ALS-18

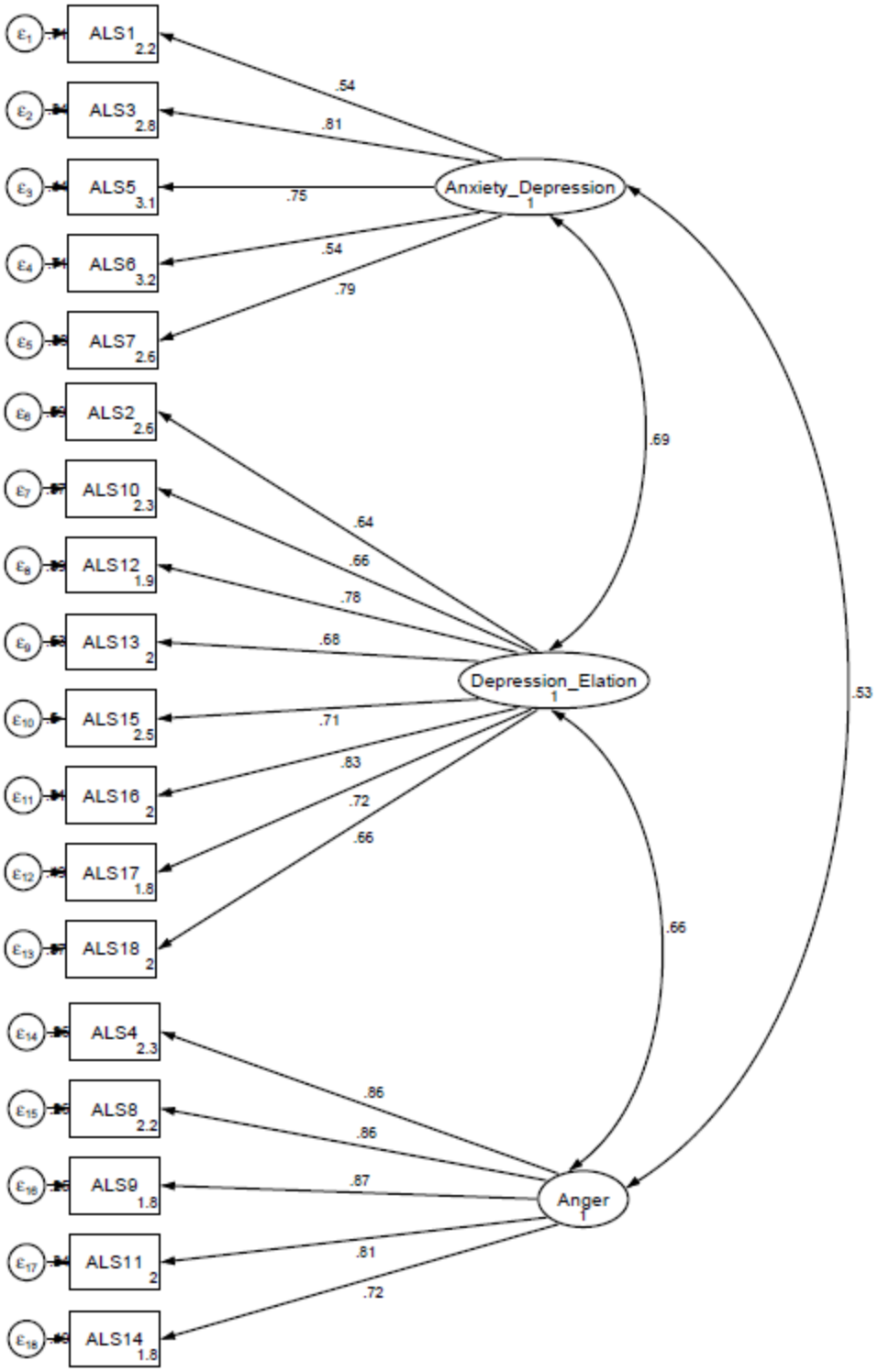

Figure 5-D.2. CFA of the three-factor model of ALS-18

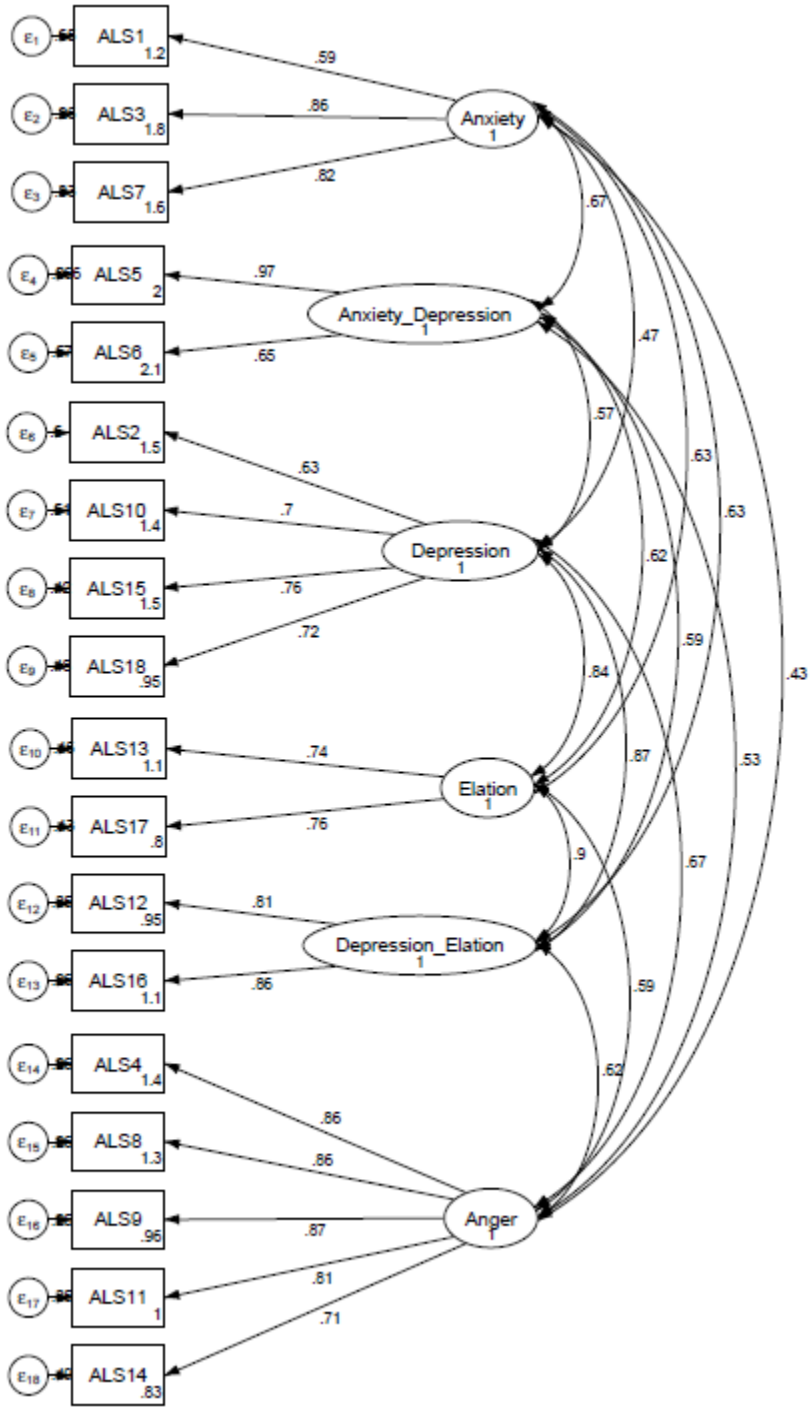

Figure 5-D.3. CFA of the six-factor model of ALS-18

Chapter 6: General discussion

Mood instability has received increased clinical and research attention. Significant correlations of MI with a variety of psychopathologies are known to occur in general and clinical samples, including depression and anxiety (Bowen, R., Baetz, Hawkes, & Bowen, 2006; Marwaha, Balbuena, Winsper, & Bowen, 2015). In addition, the transition toward motherhood has been recognized as a time of greater vulnerability for women to develop mood related symptoms including depression, anxiety, and MI (Bowen, A, Bowen, Balbuena, & Muhajarine, 2012; Kessler et al., 2003; Steiner, Dunn, & Born, 2003). Perinatal mood disorders, particularly perinatal depression and anxiety, have been investigated extensively (Leigh & Milgrom, 2008; Pope, S. & Pope, 2000). Despite the recognition of a high prevalence of MI in perinatal women, little is currently known about MI during pregnancy and the postpartum period. Further, the risk factors that may increase a woman's vulnerability to experience perinatal MI have not been confirmed. The potential effects of antenatal MI on neonatal outcomes have also received little research attention or recognition, and no-known studies have examined the relationship. Furthermore, little is known about whether existing instruments of MI are valid in measuring MI in perinatal women.

Thus, there is a compelling rationale for perinatal MI research. However, the intense focus of research on perinatal depression and anxiety has meant that other distressing psychological symptoms tend to be overlooked, including symptoms of MI. Given the importance of early detection and intervention, this comparative lack of recognition of the affective states may lead to some expectant and new mothers who are experiencing MI to be overlooked, and potentially left unsupported and untreated.

Several of the major risk factors for perinatal depression and anxiety are psychosocial and behaviour in nature (e.g., stress, smoking. social support), and a cross-sectional study has

suggested that the same factors may also be important risk factors for MI in the general population (Marwaha, Parsons, Flanagan, & Broome, 2013). In terms of the longitudinal relationship between MI and depression, Marwaha et al. (2015) found that MI predicts depression inception after 18 months in a population study, while Thompson, Berenbaum, and Bredemeier (2011) found a significant association between MI and major depressive disorder after controlling a major depressive episode at baseline in a student sample. Thus, it is vital that cross-sectional and prospective longitudinal research examines the potential role of MI and these factors in perinatal MI, which should include the examination of risk factors for MI, the association between antenatal MI and PPD, and effects of antenatal MI on neonatal outcomes. In addition, there is a lack of research on the validation of instruments for measuring MI in perinatal women. Therefore, in order to gain a comprehensive understanding of perinatal MI, a broad range of possible predictors, including mental health, interpersonal, social, and non-psychological factors, need to be considered. Additionally, effects on neonatal outcomes exerted by MI during pregnancy should be investigated, and finally, determining the psychometric properties of instruments for measuring MI in perinatal women is necessary.

6.1 Overview of dissertation objectives

The above rationale provided the impetus for the following four manuscripts presented in this dissertation. The main objectives of this study were therefore to:

1. Review the currently existing research of MI in the perinatal women systematically;
2. Examine a broad range of factors that have previously been identified as risk factors for perinatal depression and anxiety, and to assess their potential role in perinatal MI;
3. Explore the longitudinal relationship between antenatal MI and PPD while

controlling antenatal depression, psychosocial and non-psychosocial factors;

4. Examine the trajectory of MI through the perinatal period potential (from early pregnancy, to late pregnancy and to postpartum);

5. Investigate the effects of antenatal MI, depression, and anxiety on neonatal outcomes including 1-minute Apgar, 5-minute Apgar, BW, BW for gestational age, and PTB;

6. Explore construct validity of the ALS-18 in pregnant and postpartum women with mood symptoms.

6.2 A systematic review: perinatal mood instability

Perinatal MI has been observed in women during their reproductive years (Bowen, A et al., 2012; Bowen, R, Bowen, Baetz, Wagner, & Pierson, 2011; Mitchell, 2017). Existing MI research on general and clinical populations indicate that MI is strongly associated with a variety of mental disorders (Bowen, R. et al., 2006; Marwaha et al., 2015; Thompson et al., 2011). However, limited research has focused on MI in the perinatal population.

A systematic review of existing literature published between January 1985 and July 2017 was conducted in this study. A total of 1,927 abstracts were returned from the search and with 1,063 remained for abstract screening after duplicate removal. Only seven studies were deemed relevant and selected for final analysis. Only two of those articles investigated perinatal MI, one study examined the relationship between maternal emotional dysregulation and mother-infant interaction, and the rest of the articles primarily explored PPD, PPB, or experience of being pregnant, while perinatal MI was a component of the studies.

A significant gap of research in perinatal MI was recognized in the review. As the first known systematic review of MI in pregnant and postpartum women, the findings indicated that MI is a prominent feature in perinatal women, MI in the early postpartum is an important

predictor for late psychopathology up to 14 months postpartum, and maternal emotion dysregulation impedes child development. Studies also suggest that mood regulation training and coping skill education would improve mothers' ability to regulate mood and emotion.

6.3 Understanding perinatal mood instability

In order to better understand perinatal MI, the current study focused on the risk factors that were associated with perinatal MI cross-sectionally, the longitudinal relationship between antenatal MI and PPD, and the trajectory of MI through perinatal period. To the best of our knowledge, this is the first study to investigate perinatal MI in relation to its risk factors, PPD, and trajectory.

6.3.1 Risk factors for perinatal mood instability

Risk factors for perinatal depression and anxiety have studied extensively. Studies found an array of different categories of risk factors including mental health, demographic, psychosocial, behaviour, and obstetric variables (Robertson, E, Celasun, & Stewart, 2003; Robertson, E., Grace, Wallington, & Stewart, 2004). In regards to risk factors for MI, a cross-sectional study of the population-based survey found that depression, stress, low SES, young age, and being women were associated with MI (Marwaha et al., 2015; Marwaha et al., 2013). However, risk factors for perinatal MI have not be examined according to our systematic review findings described above.

In the current study, we investigated the association between perinatal MI and its risk factors including depression, psychosocial, behaviour, obstetric, and demographic variables. Among these risk factors, three risk factors emerged from the multivariate linear regression analysis: depression, history of depression, and stress at T1, T2, and T3, and labour/birth complications at T3. Women with depression had significantly elevated MI scores at T1, T2, and

T3 when compared with women without depressive symptoms. Women who reported having a history of depression showed a significantly higher level of MI scores cross-sectionally at T1, T2, and T3, while the finding still held when women who were currently depressed were excluded from analysis at T1 and T3, which may indicate that history of depression as a risk factor for MI is not driven by current depression. Experiencing stress in all stages of pregnancy and postpartum significantly and consistently increased the level of MI. If women did not have labour/birth complications, their risk for an elevated level of MI was significantly lowered at postpartum.

6.3.2 The association between antenatal mood instability and postpartum depression

Ample studies of perinatal mood disorders have investigated the longitudinal relationship between antenatal risk factors and PPD, and found that mental health, psychosocial, behaviour, demographic, and obstetric risk factors, such as antenatal depression, elevated stress, and lack of social support during pregnancy are associated with PPD (Heron et al., 2004; O'Hara & McCabe, 2013). However, the relationship between antenatal MI and PPD had not been examined despite the fact that pregnant women experience a higher level of MI.

Prospectively, we explored the relationship between antenatal MI and PPD. We found that MI at 17 weeks of pregnancy was significantly associated with depression at four weeks of postpartum while controlling for depression, and other psychosocial and non-psychosocial variables at 17 weeks of pregnancy, suggesting that MI during early pregnancy is an independent risk factor for subsequent PPD. An elevated level of MI at 31 weeks of pregnancy was not recognized as a risk factor for PPD. In addition, women with depression symptoms during pregnancy were found to be significantly associated with depressive symptoms after giving birth, and experiencing less stress during pregnancy was identified to be a protective factor for

developing PPD. These findings are in agreement with other previous studies (Chojenta, Loxton, & Lucke, 2012; O'Hara & McCabe, 2013; Pope & Pope, 2000; Robertson, E. et al., 2004; Steiner, 1998, 2002).

6.3.3 The trajectory of perinatal mood instability

Similarly, the trajectory of perinatal mood disorders has been documented; a majority of studies found that depressive and anxiety symptoms have a declining trend from pregnancy to postpartum (Evans, J, Heron, Francomb, Oke, & Golding, 2001; Heron et al., 2004; Pope, S. & Pope, 2000; Smith & Howard, 2008). No studies of the trajectory of perinatal MI were found in the current existing literature from our systematic review.

The current study examined the trajectory of perinatal MI, and found an overall declining trend from early pregnancy (T1), late pregnancy (T2), and postpartum (T3). Specifically, perinatal women experience the highest level of MI at T1, a slightly lower level at T2, and a 13.71% decrease from T2 to T3. The declining of MI level from T2 to T3 was statistically significant, which suggests that pregnant women are more likely to experience elevated MI symptoms than postpartum women. We also evaluated the trajectory of MI in women with depression, more stress, or history of depression, and found that the trajectory of MI did not change significantly, suggesting that women with depression, higher levels of stress or history of depression had experienced a significantly higher level of MI through the entire perinatal period in comparison to women who were not depressed, less stressed, or no history of depression. Furthermore, the trajectory of depression in depressed women showed no significant change with a slightly increasing trend from T1 to T3. However, MI level in depressed women had declined from T1 to T3, suggesting that MI has its distinct trajectory among depressed women during the perinatal period.

6.4 Effects of antenatal mood instability, depression, and anxiety on neonatal outcomes

Study findings of the relationship between antenatal depression and neonatal outcomes, and between antenatal anxiety and neonatal outcomes have been inconsistent. For example, studies conducted in developing countries (e.g., Bangladesh, India) have shown a positive relationship between antenatal depression and neonatal outcomes (Nasreen, Kabir, Forsell, & Edhborg, 2010; Patel & Prince, 2006), whereas studies conducted in developed countries (e.g., Sweden, England, and the current study in Canada) indicated no significant relationship between antenatal depression and neonatal outcomes (Andersson, Sundström-Poromaa, Wulff, Åström, & Bixo, 2004; Evans, J., Heron, Patel, & Wiles, 2007). Some studies have found a positive relationship between antenatal anxiety and neonatal outcomes (Dayan et al., 2006; Goedhart et al., 2010; Li, Liu, & Odouli, 2008), while other studies have reported no significant associations (Andersson et al., 2004; Berle et al., 2005; Flynn, McBride, Cely, Wang, & DeCesare, 2015; Larsson, Sydsjö, & Josefsson, 2004). Again, we could not find information on the association between antenatal MI and neonatal outcomes according to our systematic review findings.

The current study investigated effects of antenatal MI, depression, and anxiety on neonatal outcomes. We found that antenatal MI and depression did not show significant effects on neonatal outcomes (1-minute Apgar score, 5-minute Apgar score, BW, BW for gestational age, and PTB). However, antenatal anxiety, and several other measures were associated with an increased risk of LBW, and low 1 and 5-minute Apgar score, and /or SGA.

In this study cohort, elevated anxiety symptoms at T2 was found to be significantly associated with LBW, and low 1-minute and 5-minute Apgar score, and experiencing a higher level of stress at T2 was identified to have an increased risk for having a baby with SGA, which is in agreement with other studies (Dayan et al., 2006; Goedhart et al., 2010; Li et al., 2008).

Non-smoking during pregnancy was recognized as a protective factor for SGA, which is in line with other studies (Chiolero, Bovet, & Paccaud, 2005; Raatikainen, Huurinainen, & Heinonen, 2007; Suzuki et al., 2008). Finally, being primiparous was significantly associated with LBW and SGA in the current study, which is also consistent with previous studies (Shah, 2010).

6.5 Factor structure and psychometric properties of ALS-18 in pregnant and postpartum women

Affective lability has been measured by different instruments, mostly among general and clinical samples. In a systematic review, Marwaha et al. (2014) identified a total of 24 distinct measures that were utilized in a variety of mental disorders, and found that the ALS-54 (Harvey, Greenberg, & Serper, 1989) has good internal consistency and is the most frequently used instrument in the area of affect lability studies. The ALS-54 focused on a six-factor model of affect lability: depression, anxiety, elation, and anger as well as the proneness to oscillate between depression and elation, and between depression and anxiety. The ALS-18 (Oliver & Simons, 2004) is a short version of the ALS-54, and is also a widely used measure of labile affect as it consumes less time, and its psychometric properties have been studied in non-clinical and clinical populations. The ALS-18 item version is rested on a three-factor model of affective lability (anxiety/depression, depression/elation, and anger), and each factor includes at least two items from each of the original six subscale version in the ALS-54. However, the constructs of ALS-18 have not previously been validated in pregnant and postpartum women despite the fact that affective lability is a prominent feature in perinatal women.

In the current study, we examined whether ALS-18 could serve as an effective measure of affective lability in pregnant and postpartum women with mood symptoms. To examine the psychometric properties of ALS-18, CFA was performed to evaluate the factor structure within a

measurement model and to determine how well the measurement model fits to its data. We found the three-factor model demonstrated a close to acceptable fit, while the six-factor model, where ALS-18 items were assigned to their original ALS scale, indicated a better fit over the three-factor model, which replicated findings from the original ALS-18 study by Oliver and Simons (2004). Overall, we found that ALS-18 can be used as an instrument for measuring affective lability in perinatal women.

6.6 Contributions of this research and suggestions for future work

The findings in Chapter 2 represent the first study to systematically review the currently available literature on the state of perinatal MI, its relation to perinatal depression, and its association with child outcomes. The chapter contributes by indicating a significant gap in perinatal MI research. This is the first study, to date, to identify that very limited studies exist in the area of perinatal MI, particularly, there is a lack of recent studies (only three articles were published within ten years). Although we extended the literature search from 1985 to 2017, only seven articles met the inclusion criteria over a span of more than 30 years. Furthermore, only three articles were perinatal MI related, and the rest represented perinatal MI as a component of PPD or a symptom of being pregnant. The remarkable gap in perinatal MI research significantly impedes our understanding of perinatal MI. We lack a comprehensive grasp of the subject, for example, the etiology of perinatal MI, genetic influences, the mechanisms through which risk factors would affect perinatal MI, the relationship between perinatal MI and other mood disorders during the same period, and occurring outside of pregnancy and postpartum, and effects on neonatal, child, and mother outcomes.

Chapter 3 and 4 examined MI in pregnant and postpartum women cross-sectionally and longitudinally, and the effects of MI on neonatal outcomes. The FIP is the first known

prospective longitudinal study that assessed perinatal MI using VAS at early and late pregnancy and postpartum, which provided valuable information for research on MI in pregnancy and postpartum women, thus increase our understanding of perinatal MI. The strengths of the study include a relatively large community sample, the longitudinal nature of the data, and the repeated assessments of participants. The data collection was conducted by the same training research assistants that maintained consistence in assessments (Pannucci & Wilkins, 2010). In addition, assessing MI in quantitative research tends to quantify the level of individuals' experiences of MI, which would not indicate how individuals feel about MI, what individuals' thoughts about frequent and extreme mood fluctuations are, how they cope emotionally, and what impact MI has on individuals' lives. In order to present and interpret perinatal women's own experiences of MI in a narrative manner, future studies could focus on women's perspective, and lived experience of perinatal MI by utilizing qualitative research methods.

Chapter 3 represents the first known study to investigate risk factors on the course of MI in pregnant and postpartum women, the association of antenatal MI with PPD, and the trajectory of MI from early pregnancy, to late pregnancy and to postpartum. The findings revealed the risk factors for MI cross-sectionally, and the relevance of individual risk factors on the course of MI during pregnancy and postpartum was investigated using linear mixed models (LMM) with intercept as a random effect. The study examined the longitudinal relationship between antenatal MI and PPD, and we also examined the trajectory of perinatal MI by utilizing LMM to identify group differences (e.g., depressed vs. non-depressed). In addition, we compared the level of perinatal MI and depression between women who took antidepressant medications and women who did not take antidepressants, but we suggested interpreting the results with caution due to that only a small number of women (n = 13) took antidepressant medications at T2, and

counseling or medication compliances were not taken into consideration. Future studies could investigate the effectiveness of antidepressants on perinatal MI in a larger sample, and other covariates should be considered. Furthermore, the positive relationship between depression and MI has been demonstrated in general and clinical populations, and the current study replicated the finding in perinatal women both cross-sectionally and longitudinally. To understand the relationship, studies illustrate that depression and MI share some common correlations, such as neuroticism, trait negative affect, and stress (Beatson & Rao, 2013; Bowen, R, Mahmood, Milani, & Baetz, 2011; Denollet & De Vries, 2006; Miller, D., Vachon, & Lynam, 2009; Miller, J. & Pilkonis, 2006; Quilty, Sellbom, Tackett, & Bagby, 2009). The current study found that elevated stress was associated with both MI and depression in perinatal women. Neuroticism and negative affect have been found to be correlated with depression in perinatal women (Robertson, E. et al., 2004; Stewart, Robertson, Dennis, Grace, & Wallington, 2003), and future studies could investigate the association of perinatal MI with neuroticism and negative affect.

Chapter 4 examined effects of antenatal MI, depression, and anxiety on neonatal outcomes, which is the first known research focused on determining the association between antenatal MI and neonatal outcomes. The findings of the study showed that there was no correlation of antenatal MI with neonatal outcomes, which contributes to research in regards to understanding the effects of antenatal MI on neonatal outcomes. The results of effects of antenatal depression and anxiety on neonatal outcomes in the current study replicated other previous studies (Andersson et al., 2004; Evans, J. et al., 2007; Glover, O'Connor, & O'Donnell, 2010; Khashan et al., 2014). Furthermore, unlike a majority of studies that examined the relationship only at one time point during pregnancy, our study used two time points (T1 and T2) of pregnancy separately and combined, which enabled us to further understand the effects of

antenatal MI, depressive, and anxiety on neonatal outcomes across the antenatal period: a period with increased risk of mood related symptoms and disorders. In the current study, BW for gestational age is categorized into SGA (< 10^{th} percentile), AGA (within 10^{th} and 90^{th} percentile), and LGA (>90^{th} percentile) in accordance to published recommendations. Original score categories above 10^{th} percentile were collapsed to obtain a manageable number of categories to perform logistic regression. Future studies could investigate effects of MI on LGA with a larger sample.

Chapter 5 represents the first known study to examine factor structure and psychometric properties of ALS-18 in pregnant and postpartum women. Identifying the number of dimensions that underlie a particular mental disorder is essential in understanding its etiology and outcomes (Cosgrove et al., 2011). The previous research tested ALS-18 in nonclinical samples of undergraduate students (Look, Flory, Harvey, & Siever, 2010), and its psychometric properties have been studied in clinical populations (Aas et al., 2015; Look et al., 2010; Weibel et al., 2017). In regards to instruments in measuring perinatal MI, a majority of measures in assessing perinatal MI have been used either one single question about mood fluctuation (Wilkinson, 1999) or VAS (Bowen, A et al., 2012; Hapgood, Elkind, & Wright, 1988), of which its psychometric properties were not examined. As the first study to date, we found that ALS-18 can be an effective instrument of measuring affective lability in perinatal women with various mood symptoms. Our sample size is relatively small; future studies with a larger sample are required to examine the psychometric properties of ALS-18 in pregnant and postpartum women, and conduct a cross-validation test to evaluate model outside of the sample to increase the generalizability of the findings.

A comparison of study findings between the existing quantitative studies (based on our systematic review) and the current studies is presented in Figure 6.1 and Appendix 6-A: Table 6-A.1.

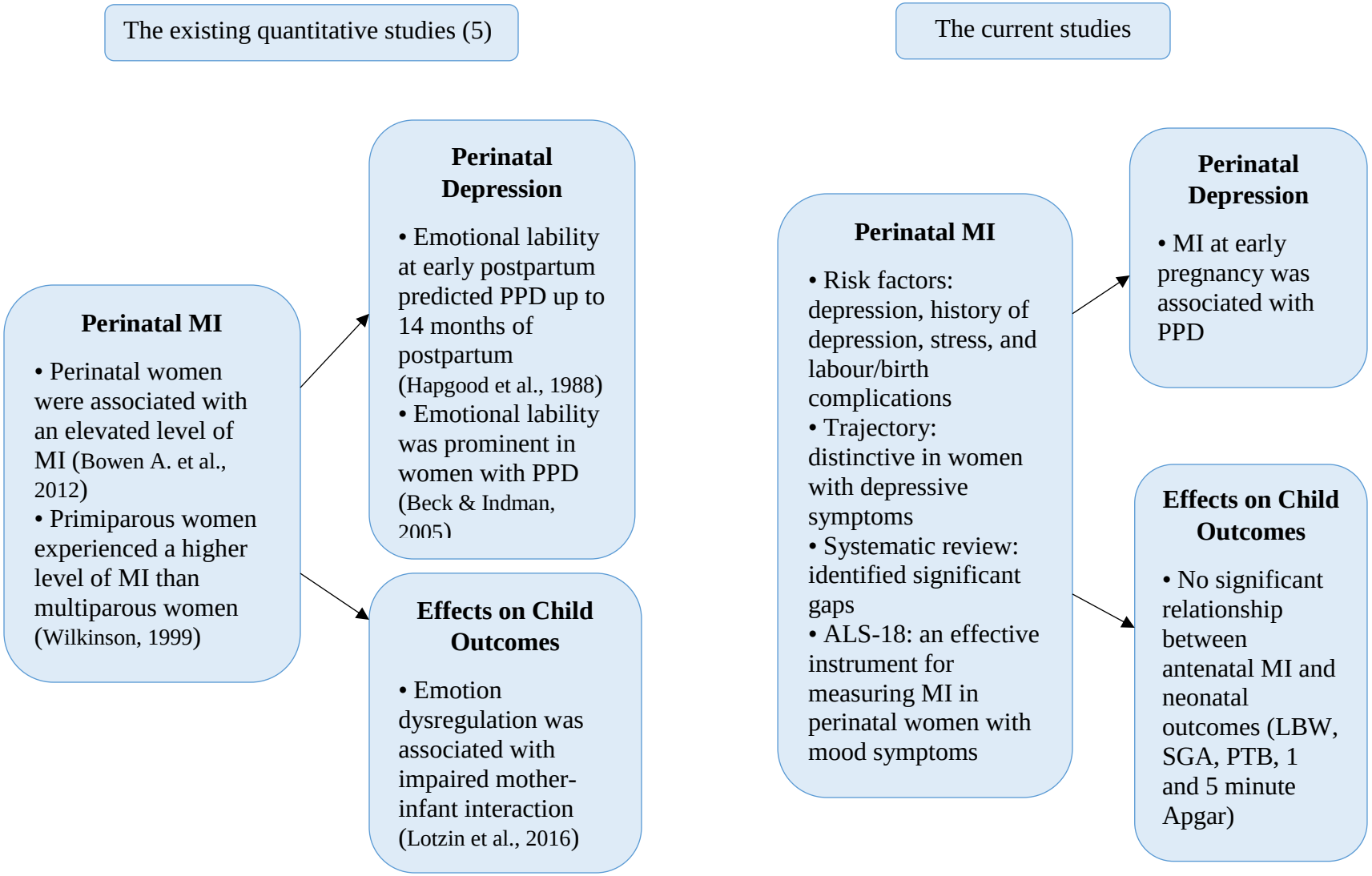

Figure 6.1 Comparison of study findings between the existing quantitative studies and the current studies

6.7 Limitations of the research

The study findings should be interpreted with caution given several study limitations. First, the majority of the sample was Caucasian and well-educated. According to the 2016 Census of Canada (Statistic Canadian, 2018), 25.8% of females between 25 and 34 years old, and 24.4% of females between 35 and 44 years old in Saskatchewan have a high school diploma or higher education (there was no information on women 18-25 years old, and only had 15 years old and over) compared with 70.1% of the current sample. In addition, Aboriginal people accounted for 15.6% of the total population of Saskatchewan compared with 7.2% in the FIP sample and 11.5% in the MMHP sample (Statistic Canadian, 2018). This limits the generalizability of the results to women who have lower education attainment, and who are aboriginal. Being an Aboriginal woman is associated with a higher risk for perinatal mood related disorders (Bowen, A. & Muhajarine, 2006; Bowen, A, Stewart, Baetz, & Muhajarine, 2009). The aboriginal population has been correlated with lower SES, and one of the gaps in the research literature is risk factors for perinatal mood disorders that are specific to women from low SES backgrounds (Reading & Wien, 2009; Robertson, E. et al., 2004). In addition, a growing body of research suggests that immigrant women have higher rates of depression prenatally and postnatally (Mechakra-Tahiri et al. 2007; Miszkurka, Goulet, & Zunzunegui, 2010; Stewart et al. 2008; Zelkowitz et al. 2008). Research on Canadian immigrant women shows that immigrant women constitute a high-risk group for depression (Stewart et al., 2008), and pregnant immigrant women may be at particularly high risk (Zelkowitz et al., 2004). Thus, future research should focus on investigating the factors that increase vulnerability to experience MI and other mood related disorders specifically in perinatal aboriginal and immigrant women, and in perinatal women with low SES.

Second, the measures used in the current study relied on participants' subjective report and retrospective recall. Retrospective recall can be influenced by cognitive processes used to reconstruct past events (Schwartz & Rapkin, 2004). Individuals are more likely to recall or report the experiences that seem more personally relevant, and are more likely to recall memory that is congruent rather than incongruent with their current feelings (Fredrickson, 2000). Particularly, physical, cognitive, and emotional changes among perinatal women have been documented that might have affected the objectiveness when women answered the questionnaires (Franzini & Fernandez-Esquer, 2004). For example, some women often experience severe nausea and vomiting during the early stages of pregnancy that may influence their self-report on psychological states in general (Swallow, Lindow, Masson, & Hay, 2004). Third, self-reported risk behaviours such as smoking, alcohol consumption, and drug use are often under-reported, particularly during the perinatal period because of social desirability bias (Alvik, Haldorsen, & Lindemann, 2005; Van de Mortel, 2008). Fourth, we used baseline information including demographic predictors, which may have changed over the perinatal period. However, one advantage of this approach can lead to identifying risk factors early during pregnancy that provides the opportunity for early intervention for at risk women.

Finally, the study results cannot be used to make causal inferences about the relationships between study variables, since mental health status, especially depression, has been found to alter people's perceptions of emotion, and perceptions of stress, and availability and utilization of social support (Michels, Kruske, & Thompson, 2013; Reay et al., 2012).

6.8 Implications

Pregnancy and the postpartum provide a unique opportunity to screen and assess women for mood related symptoms, since most women have the regular medical contact during this

period. The findings of manuscripts one to four have important implications for the mood related symptoms screening because the current focus on depression and anxiety measured by the EPDS will not likely to detect many of the women who experience perinatal MI (Miller, R. L., Pallant, & Negri, 2006; Rallis, Skouteris, McCabe, & Milgrom, 2014; Wardrop & Popadiuk, 2013). Given the high prevalence of MI in perinatal women, there is a need to accurately screen and detect MI in expectant and new mothers. In addition, the findings indicate that the ALS-18 can be an effective tool for measuring perinatal MI.

However, little research has examined perinatal MI as a distinct affective state, as the manuscript one indicated. Increasing our understanding of MI during the perinatal period may have important implications for both public and clinical practice since the presence of perinatal MI may impact on the strategies and resources utilized by health related agencies and health professionals. Due to the fact of normalizing perinatal MI, increasing awareness among the public, particularly perinatal women, through health promotion is essential. For health professionals, early detection and intervention of women who experience MI during the perinatal period are key. In addition, the high prevalence of perinatal MI, and the relationship between perinatal MI and depression may itself potentially result in PPD if it is not resolved (Marwaha et al., 2015; Thompson et al., 2011). Thus, although the treatment of perinatal depression is generally considered to take precedence (Miller et al., 2006), the psychological wellbeing of new mothers is likely to be optimized by tailoring the treatments to their comorbid perinatal MI symptoms, if present, as they might be expected to interact with each other to worsen the symptoms (Marwaha, Parsons, & Broome, 2013).

The study findings in manuscript two identified that MI during early pregnancy was a predictor of PPD. Mood instability is generally shown to decrease after childbirth according to

our study results. Thus, the findings point to the importance of developing specialized interventions, to be delivered by mental health professionals, and counselors, who target MI symptoms before the birth. For example, working with expectant women to educate them on MI including possible impact on women's mental health, relationship with their partner, and interaction with their infant after giving birth, to learn coping skills to manage MI including how to recognize MI and regulate MI, to facilitate women to increase ability and confidence in managing MI including role-playing, or if necessary, to implement pharmacologic intervention.

One challenge for primary health care providers in identifying perinatal MI, and facilitating further referrals, is the tendency for them to predominantly consult with mothers alone during perinatal period. Possibilities for increasing awareness of MI among the partner and family are very important, as there is evidence that social support plays an essential role in managing perinatal mood disorders (Corrigan, Kwasky, & Groh, 2015; Reid & Taylor, 2015). Health professionals should work with expectant and new mothers, their partners, and other support that goes beyond the marital relationship, including women's mothers and close friends in regards to health promotion, therapy sessions, and treatments.

Furthermore, the link between prenatal MI and labour/birth complications has important healthcare implications. The study results indicated that the women who had labour/birth complications were at a greater risk of experiencing MI four weeks after delivery. Thus, it is prudent to provide additional education, and psychological support to women who undergo labour/birth complications to reduce the level of MI, or decrease the possibility of MI from occurring during postpartum period.

As the ability to engage in screening and the provision of possible assessment tools in primary care settings can be limited by health care professional time and service demands, one

option is for health care professionals to consider using the ALS-18 as an initial screening tool. The ALS-18 has the advantage of being a short and easily administered scale, and as demonstrated in the current study, it can be an effective instrument for measuring perinatal MI. If a woman is found to score highly on the ALS-18, a referral can be made. Additionally, hospitals, primary care settings, and programs that were specifically designed for perinatal related care, for example, the MotherFirst in Saskatchewan, have social work service or referral service available to women undergoing antenatal or early postnatal care, and referrals can be made by midwifery, nurses, or obstetric staff, or women can be encouraged to self-refer. Due to the potential for untreated mental health concerns to have deleterious effects on new mothers, their infants, and the wider community, developing clear screening and referral pathways is important for the overall well-being of mothers, babies, and their families, and also for future research and clinical practice.

6.9 Conclusions

The current study filled some of the gaps that were identified in our systematic review of perinatal MI, and adds to the ongoing understanding of perinatal mood symptoms, specifically MI. We were able to identify the risk factors for perinatal MI at early and late pregnancy, and postpartum: depression, history of depression, stress, and labour/birth complications, and antenatal MI at early pregnancy was found to be a significant risk factor for postpartum depression. Although the trajectory of perinatal MI for the whole sample follows a similar evolution of perinatal depression over the perinatal period, it had a distinct trajectory for women who experienced depressive symptoms. In addition, the findings of the association between antenatal MI and neonatal outcomes were negative in the current study. However, antenatal anxiety emerged as a prominent risk factor for LBW, and low 1-minute

and 5-minute Apgar scores, alleviating stress and smoking cessation during pregnancy were recognized as protective factors for having a baby with SGA, and being first time mother was significantly associated with LBW and SGA. Furthermore, the psychometric properties of ALS-18 were validated in perinatal women, and the results showed that the ALS-18 can be an effective instrument in measuring MI in perinatal women with mood symptoms. Our findings support the need for health promotion that increases awareness of perinatal MI, for early detection and early intervention of perinatal MI by adding MI screening into routine perinatal care, and for targeting perinatal women with certain characteristics, most notably depression, anxiety, history of depression, high stress level, and labour/birth complications. Prioritizing these needs may help to recognize women at greater risk of developing mood related symptoms during pregnancy and postpartum, thus appropriate interventions and supports can be provided, and ultimately the health of women, their babies, and their families can be improved.

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6.11 Appendix 6-A: Table of comparison between existing quantitative studies and the current studies

Table 6-A.1: Comparison between existing quantitative studies (5) and the current studies

Existing quantitative studies							Contributions of the current studies
Author (Year), Country	Study design	Sample size	Measures	Time points		Major findings	
				Antenatal	Postpartum		
Beck and Indman (2005), US	Cross-sectional	133 postpartum women with depression	The Postpartum Depression Screening Scale (PDSS)		16 weeks	Scores on all seven dimensions of the PDSS were elevated. Dimension of emotional lability had the highest mean score among the 7 dimensions.	1.Longitudinal study-at three time points during the perinatal period 2.Larger sample size – followed women from early pregnancy to postpartum 3.Investigated the relationship between perinatal MI and its risk factors, between antenatal MI and PPD, and the trajectory of perinatal MI 4.Used VAS (5-item questionnaires) primarily to assess perinatal MI (In the existing study, emotional lability is only one component of PDSS) 5.Used EPDS to assess depressive symptoms. EPDS has been validated in perinatal women worldwide, and the most used instrument for measuring perinatal depression

Table 6-A.1: Comparison between existing quantitative studies (5) and the current studies continues

Existing quantitative studies							Contributions of the current studies
Author (Year), Country	Study design	Sample size	Measures	Time points		Major findings	
				Antenatal	Postpartum		
Bowen A. et al. (2012), Canada	Prospective cohort	45 pregnant women 31 women in control group	VAS, EPDS	16 and 30 weeks	4 weeks	Perinatal women showed higher mean levels of irritable, anxious, and high MI than the non-perinatal women. The findings still held when pregnant women with depressive symptom were excluded from the study.	1.Larger sample size 2.Investigated the relationship between perinatal MI and its risk factors, and identified risk factors: depression, history of depression, more stress, and labour/birth complications 3.Examined association between antenatal MI and PPD, and found antenatal MI at early pregnancy as an independent risk factor for PPD 4.Explored the trajectory of perinatal MI

Table 6-A.1: Comparison between existing quantitative studies (5) and the current studies continues

Existing quantitative studies							Contributions of the current studies
Author (Year), Country	Study design	Sample size	Measures	Time points		Major findings	
				Antenatal	Postpartum		
Hapgood, Elkind, and Wright (1988), New Zealand	Prospective cohort	66 postpartum women	VAS, the Goldberg semi-structured psychiatric interview		0-2, 6, 13, 26, and 60 weeks	Emotional lability was the important affective component of the early postpartum. Lability of mood in the early postpartum was related to psychiatric symptoms up to 14 months postpartum and was the strongest predictor of later psychopathology.	1.Larger sample size – followed women from early pregnancy to postpartum 2. Investigated the relationship between perinatal MI and its risk factors, and the trajectory of perinatal MI 3.Examined relationship between MI and PPD outside of the early postpartum period, and found MI at early pregnancy to be a significant risk factor for PPD 4.Used EPDS to assess depressive symptoms

Table 6-A.1: Comparison between existing quantitative studies (5) and the current studies continues

Existing quantitative studies							Contributions of the current studies
Author (Year), Country	Study design	Sample size	Measures	Time points		Major findings	
				Antenatal	Postpartum		
Lotzin et al. (2016), Germany	Cross-sectional	68 postpartum women 68 infants	The Difficulties in Emotion Regulation Scale, the Still-Face paradigm		24 weeks	Higher maternal emotion dysregulation was significantly associated with higher facial affect synchrony; the relationship between the effect of maternal psychopathology and facial affect synchrony was fully mediated by emotion dysregulation.	1.Longitudinal study-at three time points during perinatal period 2.Larger sample size of perinatal women 3. Investigated the effects of antenatal MI, depression, and anxiety on neonatal outcomes, and found no association between perinatal MI and neonatal outcomes 4.Used EPDS to assess maternal depressive symptoms

Table 6-A.1: Comparison between existing quantitative studies (5) and the current studies continues

Existing quantitative studies							
Author (Year), Country	Study design	Sample size	Measures	Time points		Major findings	Contributions of the current studies
				Antenatal	Postpartum		
Wilkinson (1999), Australia	Prospective cohort	86 pregnant women 86 women's partners	The Positive and Negative Affect Scale (PANAS), self-reported mood questionnaires	16, and 31 weeks	10 days, 13 weeks	The immediate postpartum was the peak period of positive affect for both primiparous and multiparous mothers and their male partners and was also the peak period of negative affect and mood lability for primiparous women. There was relatively little change in mood from the second to the third trimester, and in the early postpartum. However, primiparous women showed increased mood lability while multiparous women did not experience the increase.	1.Larger sample size of perinatal women 2.Investigated the relationship between perinatal MI and its risk factors, between antenatal MI and PPD, and the trajectory of perinatal MI 3.Used VAS (5-item questionnaires) to assess perinatal MI (The existing study did not specify what mood related questions were used to assess MI) Additional contributions: 1.Systematically reviewed existing literature of perinatal MI, its relation to perinatal depression, and its effects on children 2.Investigated psychometric properties of ALS-18 in perinatal women with mood symptoms

6.13 Appendix 6-B: Questionnaire for the FIP study

Questionnaire used to collect data from participants at baseline, Feeling in Pregnancy and Motherhood Study.

PRESENT PREGNANCY

How would you rate your overall health today? ❑Excellent ❑Very Good ❑Good ❑Fair ❑Poor

Date of first pregnancy check-up_____Who did you see? ❑Doctor_____

What birth control did you use? ❑none ❑condom ❑BCP ❑Mirena/IUD ❑Depoprovera other_____

Did you plan this pregnancy? ❑ Yes ❑ No ❑ sort of

Do you plan to keep the baby? ❑ Yes ❑ No ❑ unsure

How do you feel about the pregnancy? ❑happy ❑scared ❑overwhelmed ❑ not happy ❑ other_____

How does your family feel about the pregnancy? ❑happy ❑unsure ❑overwhelmed ❑not happy ❑ ___

In the two weeks:
Have you felt down, depressed or hopeless?
❑not at all ❑ several days ❑ more than ½ the days ❑nearly every day

Have you felt little interest or pleasure in doing things?
❑not at all ❑ several days ❑ more than ½ the days ❑nearly every day

Do you plan to breastfeed? ❑Yes ❑No ❑Undecided

Are you interested in Prenatal Classes? ❑Yes ❑No ❑Undecided

CURRENT PREGNANCY-please check those that apply		
❑ severe nausea/vomiting ❑ spotting/bleeding ❑ cramps ❑ headaches ❑ multiple pregnancy ❑ placenta previa	❑ incompetent cervix ❑ premature labour ❑ Hypertension (high blood pressure)/swelling ❑ Urinary Tract Infection ❑ vaginal infection ❑ StrepB infection	❑ anemia ❑ Rh factor ❑ Diabetes ❑ dental problems ❑ other

Medication	Reason	Amount	Frequency

MARITAL STATUS Are you? ❑single ❑ CL ❑married ❑divorced/separated ❑widowed

CURRENT RELATIONSHIP WITH BABY'S FATHER? ❑Yes ❑No

HOW SATISFIED ARE YOU WITH THE RELATIONSHIP? ❑ very ❑ somewhat ❑ not satisfied

EDUCATION: What grade did you finish? ☐ Grade 8 or less ☐ Grade 9 – 11 ☐ Grade 12 ☐ Some post-secondary ☐ Post-secondary ☐ Some University ☐ University

ETHNIC BACKGROUND
Are you? ☐ Caucasian ☐ Treaty –Status ☐ Non-Status ☐ Métis ☐ Other

PAST BIRTHS/ PREGNANCIES: G_____P_____T_____P_____A_____L_____

NAME	DO B	M F	Birth Wt	Gest	Complications/ Comments	Anomalies or problems with child	Breastfeed	Lives with

G=all pregnancies; **P**=20 weeks on; **T**=Term; **P**=Preterm <37weeks;
A=miscarriage<20wks/abortions; **L**=living

HEALTH HISTORY-check which things you have experienced problems with

❑ severe nausea/vomiting	☐ HIV	☐ thyroid
❑ spotting/bleeding	☐ Strep B Infection	☐ heart disease
❑ headaches	☐ anemia	☐ allergies
❑ Urinary Tract Infection	☐ Rh factor	☐ surgeries
☐ vaginal infection	☐ diabetes	☐ other
☐ Sexually Transmitted Infections	☐ seizures	☐ other
☐ Hepatitis		

HOUSING Do you? ☐ own ☐ rent ☐ parents ☐ room & board ☐ YWCA ☐ other
# of adults in household_____ # of children under 18_____

Is it Adequate/suitable? ☐ yes ☐ no ☐ unknown Plan to move: ☐ yes ☐ no when?
_____

EMPLOYMENT Do you work outside the home? ❑ Yes ❑ No
If yes, What is your occupation?_____how many hours/week do you work?_____

FINANCES Do you have any financial concerns: ❑Yes ❑No
Are you getting? ❑DCRE/social services ❑ Employment Supplement ❑ Band funding ❑ Student loan ❑ PTA
❑ parents ❑ partner ❑_____

In the past 12 months, did you or anyone else in your house.
Not have enough food to eat? ❑ Yes ❑ No
Worry that there would not be enough to eat because of a lack of money? ❑ Yes ❑ No

Do you have a history of PMS? ❑Yes❑No When did it start?_____age ❑before or ❑after pregnancies
Treated ❑Yes❑No Medication ❑Yes ❑No

Do you have a history of depression? ❑Yes ❑No when? Treated
❑Yes ❑No Medication ❑Yes ❑No

Did you have depression in previous pregnancy? ❑ Yes ❑ No when? Treated
❑Yes❑No Medication ❑Yes ❑No

Have you had postpartum depression? ❑Yes ❑No when? Treated
❑Yes ❑No Medication ❑Yes ❑No

Do your moods go up and down? ❑not at all ❑ several days ❑ more than ½ the days ❑nearly every day

Do you have mood swings that occur for no reason? ❑not at all ❑ several days ❑ more than ½ the days ❑nearly every day

Now some questions about your family…
Is your mother alive? ❑Yes ❑No If no, how old were you when she died? _____

Did your mother or any of your sisters have depression before or after giving birth? ❑unknown
Mother ❑ Yes ❑ No sister: 1 ❑ Yes ❑ No 2.❑ Yes ❑ No 3.❑ Yes ❑ No

What things are causing you the most stress right now? ❑nothing right now ***if yes what?***
❑being pregnant ❑ partner/relationship ❑not enough money ❑children ❑family
❑where I live ❑ health of my baby ❑birth of my baby ❑health ❑work
❑school ❑ Other _____ _____ _____

Do you have someone to turn to for emotional support? ❑Yes ❑No ***If yes, who gives you support?***
❑ Partner ❑ Mother *(don't ask if mother not alive)* ❑ Friend ❑ Female relatives ❑ Other_____

Who of these gives you the most support? _____
Can you count on that person to care about you no matter what? Yes ❑ No ❑

During the past year, from yesterday to one year ago yesterday…
Have you had a drink alcoholic beverages (beer, wine, coolers) at all? ❑ Yes ❑ No ***If yes,***

Did you drink alcohol?
Less than once a month ❑ once a month ❑ 2 to 3 times/month ❑
once a week ❑ 2 to 3 times a week ❑ 4-6 times a week❑ every day ❑

How often did you have more than 5 drinks at one time?
Never ❑ less than once a month ❑ once a month ❑
2 to 3 times/month ❑ once a week ❑ more than once a week❑
During the past week, did you drink alcohol? ❑ Yes ❑ No

The next three questions relate to any type of abuse you may be experiencing.
Has anyone ever hit, slap, restrained, punch, pinch, kick, beat you? ❑ Yes ❑ No
Has anyone ever yell, belittle, berate, blame, neglect? ❑ Yes ❑ No
Has anyone touched you against your will, raped you? ❑ Yes ❑ No

Have you had counseling in the past? ❑ Yes ❑ No
If yes, what for? ❑ depression ❑ relationship ❑ addiction ❑ eating disorder ❑ abuse ❑other
_____

Are you seeing a counselor right now? ❑ Yes ❑ No
If yes, why? ❑ depression ❑ relationship ❑ addiction ❑ eating disorder ❑ abuse

Do you have any legal problems? ❑ Yes ❑ No

Date:_____ Interviewer:_____person/telephone

Please underline the answer, which comes closest to how you have felt in the past 7 days, not just how you feel today:

I have felt happy:

Yes, most of the time
Yes, some of the time
No, not very often
No, not at all

In the past 7 days:

1. I have been able to laugh and see the funny side of things:
   As much as I always could
   Not quite so much now
   Definitely not so much now
   Not at all

2. I have looked forward with enjoyment to things:
   As much as I ever did
   Rather less than I used to
   Definitely less than I used to
   Hardly at all

3. I have blamed myself unnecessarily when things went wrong:
   Yes, most of the time
   Yes, some of the time
   Not very often
   No, never

4. I have been anxious or worried for no good reason:
   No, not at all
   Hardly ever
   Yes, sometimes
   Yes, very often

5. I have felt scared or panicky for no very good reason:
   Yes, quite a lot
   Yes, sometimes
   No, not much
   No, not at all

6. Things have been getting on top of me:
   Yes, most of the time I haven't been able to cope at all
   Yes, sometimes I haven't been coping as well as usual
   No, most of the time I have coped quite well
   No, I have been coping as well as ever

7. I have been so unhappy that I have had difficulty sleeping:
   Yes, most of the time
   Yes, sometimes
   Not very often
   No, not at all

8. I have felt sad or miserable:
   Yes, most of the time
   Yes, quite often
   Not very often
   No, not at all

9. I have been so unhappy that I have been crying:
   Yes, most of the time
   Yes, quite often
   Only occasionally
   No, never

10. The thought of harming myself has occurred to me:
    Yes, quite often
    Sometimes
    Hardly ever
    Never

Circle the response that fits closest to your experience during the <u>past 7 days</u>.

1. How often have you felt like being sick (nauseated) in the past week?

All the time	More than once a day	Daily	3-6 days during the week	Occasionally	Not at all

2. How often have you retched/dry heaved (but without actually being sick) in the past week?

All the time	More than once a day	Daily	3-6 days during the week	Occasionally	Not at all

3. How often have you been physically sick (vomited) during the past week?

All the time	More than once a day	Daily	3-6 days during the week	Occasionally	Not at all

Please circle a number for each one to show how much of a worry it is to you now, from 1 if it is not a worry to 5 if it is something that you are extremely worried about:

Major worry	**Not a worry**				
Your housing	1	2	3	4	5
Money problems	1	2	3	4	5
Problems with the law	1	2	3	4	5
Your relationship with your partner/husband	1	2	3	4	5
Your relationship with your family and friends	1	2	3	4	5
Your own health	1	2	3	4	5
The health of someone close to you	1	2	3	4	5
Employment problems	1	2	3	4	5
The possibility of something being wrong with baby	1	2	3	4	5
Going to hospital	1	2	3	4	5
Internal examinations	1	2	3	4	5
Giving birth	1	2	3	4	5
Coping with the new baby	1	2	3	4	5
Giving up work (if applicable)	1	2	3	4	5
Whether your partner will be with you for the birth	1	2	3	4	5
Possibility of miscarriage	1	2	3	4	5

If there is anything else that is worrying you or you would like to say anything more about any of the above,
please use this space to tell us about it:

How many drinks can you hold? _____

Have close friends or relatives worried or complained about your drinking in the last year? Yes❑ No❑

Do you sometimes take a drink in the morning when you first get up? Yes❑ No❑

Has a friend or family member ever told you about things you said or did while you were drinking that you could not remember?? Yes❑ No❑

Do you sometimes feel the need to cut down on your drinking? Yes❑ No❑

In the last month…

How much do you exercise? (walking for 20 minutes, swimming etc.)

Every day ❑
2-3 times a week ❑
Occasionally ❑
Never ❑

How much do you smoke? (√ one)

More than a pack/day ❑
5-20/day ❑
Less than 5 a day ❑
Quit since pregnant ❑
Quit before pregnant ❑ I
never smoked ❑

Does anyone else smoke inside your home? Yes❑ No❑

How often did you drink beer or other alcohol? (√ all that apply)

Occasional drink or 2 ❑
1-2 drinks a day ❑ 5+
drinks at one time ❑
Quit since pregnant ❑
Quit before pregnant ❑ I
never drank alcohol ❑

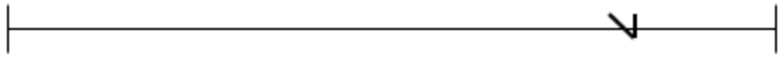
How often did you use drugs such as marijuana, crystal meth, cocaine? (√ one)

Regular (every day) ❑
Occasionally ❑
Quit since pregnancy ❑
Quit before pregnant ❑
I never use such drugs❑

Your family income: (√ one only)

Social/Band Assistance: ❑
Less than $20,000./yr ❑
$20-40,000./yr ❑
$40-60,000./yr ❑
More than $60,000./yr❑

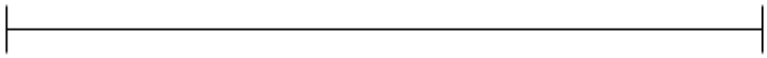
I have frequent hiccups. *(Place an 'X' on the line as below)*



Not at all true Yes, very much true

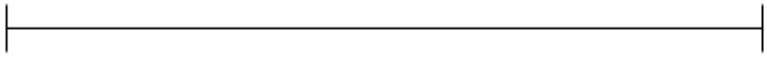
In the last <u>month</u> how much have the following statements been true for you?

1. I have frequent ups and downs of moods.



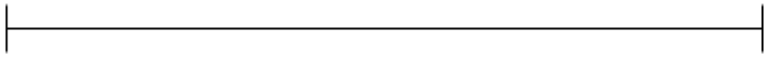
Not at all true Yes, very much true

2. I have mood swings that occur for no reason.



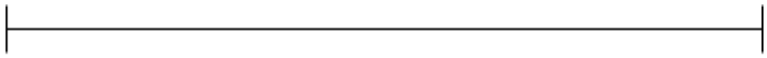
Not at all true Yes, very much true

3. Other people complain about my mood swings.



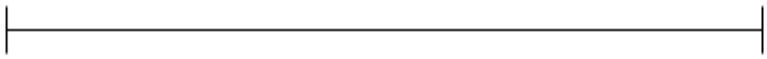
Not at all true Yes, very much true

4. Because of my moods, I have trouble following through with my plans.



Not at all true Yes, very much true

5. I don't like to make commitments because my moods might change.



Not at all true Yes, very much true

Your postal code_____

Please circle the number to indicate whether you strongly agree, agree, disagree or strongly disagree to the following statements about your community	Strongly Disagree 1	Disagree 2	Agree 3	Strongly Agree 4
This is a close knit neighborhood	1	2	3	4
People in this neighborhood can be trusted	1	2	3	4
People around here are willing to help their neighbors	1	2	3	4
People in this neighborhood do not share the same values	1	2	3	4

People in this neighborhood generally do not get along with each other	1	2	3	4
It is safe to walk alone in this neighborhood after dark	1	2	3	4
It is safe for children to play outside during the day	1	2	3	4
There are good parks, playgrounds and play spaces in this neighborhood	1	2	3	4

How do you feel about your neighborhood as a place to bring up child? Is it…

Excellent ❑ Good ❑ Average ❑ Poor❑ Very poor❑

6.13 Appendix 6-C: Questionnaire for the MMHP study

UNIVERSITY OF SASKATCHEWAN
College of Medicine

MATERNAL MENTAL HEALTH INTAKE

Saskatoon Health Region

**Please complete and bring with you to your first appointment

THIS QUESTIONNAIRE ASKS QUESTIONS THAT ARE RELATED TO YOUR PHYSICAL AND MENTAL HEALTH. PLEASE ANSWER ALL QUESTIONS AS COMPLETELY AS POSSIBLE.

PATIENT INFORMATION

Name: _____

Address: _____

Phone: (H) _____ **(C)** _____ **(WK)** _____

Date of Birth: _____/_____/_____ **HSN#** _____
Month / Day / Year

Referring Physician: _____

Height: _____ **Weight (lbs.)** _____ **Pre-pregnancy Weight** _____ **Weight gain in Pregnancy?** _____

Due Date: _____ **How many weeks ?** _____ **OR** **Date of Delivery:** _____

Is the baby healthy? ☐Yes ☐No, describe any problems:

Type of delivery: ☐normal, vaginal ☐emergency C-section ☐planned C-section ☐forceps/vacuum

Any Pregnancy, Labour or Delivery complications? No☐ Yes☐Please describe:

_____

_____

Are you breastfeeding now? ☐Yes ☐No ☐both (formula and breast)

Did you plan this pregnancy? ☐Yes ☐No ☐Sort of

Do you plan to keep the baby? ☐Yes ☐No ☐Unsure

What birth control did you use? _____

Number of pregnancies: _____ **Miscarriages/Loss of pregnancy #:** _____

Did you having trouble conceiving? ☐No ☐Yes, describe

Are you? ☐single ☐CL ☐married ☐divorced/separated ☐widowed

Current relationship with baby's father? ☐ Yes ☐No

Page 1 of 7

If you are presently in a relationship, please answer the next two questions:

1. **Which response best describes your relationship:**
   ☐ a lot of tension ☐some tension ☐ no tension

2. **Do you and your partner work out arguments:**
   ☐with great difficulty ☐some difficulty ☐ no difficulty

Education: ☐Elementary School ☐High School ☐Grade 12 ☐Technical School/Some University ☐University

Ethnic background: ☐Caucasian ☐Aboriginal/Metis ☐Other

Please select the responses that describe your current living arrangements?
☐ with spouse/partner ☐ with relatives (children/parents) ☐ live alone ☐ with others (roommates)

Please select the employment situations that describe you:
☐ full time employed ☐ part time employed ☐ student ☐ homemaker ☐maternity leave

Do you have a history of PMS? ☐Yes ☐No
Treated? ☐Yes ☐No Medication? ☐Yes ☐No

Do you have a history of depression? ☐Yes ☐No When? _____
Treated? ☐Yes ☐No Medication? ☐Yes ☐No

Did you have depression in previous pregnancy? ☐Yes ☐No When? _____
Treated? ☐Yes ☐No Medication? ☐Yes ☐No

Have you had postpartum depression? ☐Yes ☐No When? _____
Treated? ☐Yes ☐No Medication ☐Yes ☐No

Have you had any problems with eating disorders? (bulimia, anorexia, binge eating) ☐No ☐Yes, describe:

_____

_____

Do you have a history of abuse (e.g. physical or sexual)? ☐Yes ☐No

Do you have any legal problems? ☐Yes ☐No

Have you had counseling in the past? ☐Yes ☐No
If yes, what for? ☐depression ☐relationship ☐addiction ☐eating disorder ☐abuse ☐other

Do you have a family history of mental illness? ☐No ☐Yes, describe:

_____

_____

Do you have medical problems or have you had surgeries in the past?

_____

_____

Current Medications or over the counter drugs you are taking:

Medication	Reason	Amount/Frequency	Length of time taken

Allergies to medications: _____

_____

How much did you smoke? (√ one)
- More than a pack/day ☐
- 5-20/day ☐
- Less than 5 a day ☐
- Quit since pregnant ☐
- Quit before pregnant ☐
- I never smoked ☐

Does anyone else smoke inside your home?
Yes☐ No☐

How much did you exercise? (walking for 20 minutes, swimming etc.)
- Every day ☐
- 2-3 times a week ☐
- Occasionally ☐
- Never ☐

How often did you use drugs such as marijuana, crystal meth. IV drugs, Cocaine.
- Regular (every day) ☐
- Occasionally ☐
- Quit since pregnancy ☐
- Quit before pregnant ☐
- I never use such drugs ☐

How often did you drink beer or other alcohol? (√ **all that apply**)
- Occasional drink or 2 ☐
- 1-2 drinks a day ☐
- 5+ drinks at one time ☐
- Quit since pregnant ☐
- Quit before pregnant ☐
- I never drank alcohol ☐

*1. I have been able to laugh and see the funny side of things.
0 As much as I always could
1 Not quite so much now
2 Definitely not so much now
3 Not at all

*2. I have looked forward with enjoyment to things.
0 As much as I ever did
1 Rather less than I used to
2 Definitely less than I used to
3 Hardly at all

3. I have blamed myself unnecessarily when things went wrong.
3 Yes, most of the time
2 Yes, some of the time
1 Not very often
0 No, never

*4. I have been anxious or worried for no good reason.
0 No not at all
1 Hardly ever
2 Yes, sometimes
3 Yes, very often

5. I have felt scared or panicky for no very good reason.
3 Yes, quite a lot
2 Yes, sometimes
1 No, not much
0 No, not at all

6. Things have been getting on top of me.
3 Yes, most of the time I haven't been able to cope at all
2 Yes, sometimes I haven't been coping as well as usual
1 No, most of the time I have coped quite well
0 No, I have been coping as well as ever

7. I have been so unhappy that I have had difficulty sleeping.
3 Yes, most of the time
2 Yes, sometimes
1 Not very often
0 No, not at all

8. I have felt sad or miserable.
3 Yes, most of the time
2 Yes, quite often
1 Not very often
0 No, not at all

9. I have been so unhappy that I have been crying.
3 Yes, most of the time
2 Yes, quite often
1 Only occasionally
0 No, never

10. The thought of harming myself has occurred to me.
3 Yes, quite often
2 Sometimes
1 Hardly ever
0 Never

1. You were not your usual self and you felt so good or so hyper that other people thought you were not your normal self or you were so hyper that you got into trouble?	Yes	No
2. You were so irritable that you shouted at people or started fights or arguments?	Yes	No
3. You felt much more self-confident than usual?	Yes	No
4. You got much less sleep than usual and found you didn't really miss it?	Yes	No
5. You were more talkative or spoke much faster than usual?	Yes	No
6. Thoughts raced through your head or you couldn't slow your mind down?	Yes	No
7. You were easily distracted by things around you that you had trouble concentrating or staying on track?	Yes	No
8. You had much more energy than usual?	Yes	No
9. You were much more active or did many more things than usual?	Yes	No
10. You were much more social or outgoing than usual, for example, you telephoned friends in the middle of the night?	Yes	No
11. You did things that were unusual for you or that other people might have thought were excessive, foolish or risky?	Yes	No
12. You were much more interested in sex than usual?	Yes	No
13. Spending money got you or your family into trouble?	Yes	No
14. If you replied YES to more than one of the above, have several of these ever happened during the same period of time?	Yes	No

15. How much of a problem did any of these cause you—like being unable to work; having family, money, or legal troubles; getting into arguments or fights?

☐ No Problem ☐ Minor Problem ☐ Moderate Problem ☐ Serious Problem

Use the following scale: 1 - Not at all; 2 - Several days; 3 - Over half the days; 4 - Nearly every day

a.	Feeling nervous, anxious, or on edge.	1 2 3 4
b.	Not being able to stop or control worrying.	1 2 3 4
c.	Worrying too much about different things.	1 2 3 4
d.	Trouble relaxing.	1 2 3 4
e.	Being so restless that it's hard to sit still.	1 2 3 4
f.	Becoming easily annoyed or irritable.	1 2 3 4
g.	Feeling afraid as if something awful might happen.	1 2 3 4

If you checked off any of the above problems, how difficult have these made it for you to do your work, take care of things at home, or get along with other people?

☐ Not difficult at all ☐ Somewhat difficult ☐ Very difficult ☐ Extremely difficult

Below are five statements with which you may agree or disagree. Using the scale below, indicate your agreement with each item.

1 Strongly disagree; 2 Disagree; 3 Slightly disagree; 4 Neither agree or disagree; 5 Slightly agree; 6 Agree; 7 Strongly agree

In most ways my life is close to my ideal.	1 2 3 4 5 6 7
The conditions of my life are excellent.	1 2 3 4 5 6 7
I am satisfied with life.	1 2 3 4 5 6 7
So far I have gotten the important things I want in life.	1 2 3 4 5 6 7
If I could live my life over, I would change almost nothing.	1 2 3 4 5 6 7

Please rate the next group of sentences according to the following scale during the last week:

① **Not at all like me** (Very undescriptive) ② **Not really like me** (Rather undescriptive) ③ **Somewhat like me** (Rather descriptive) ④ **Exactly like me** (Very descriptive)

1.	At times I feel just as relaxed as everyone else and then within minutes I become so nervous that I feel light-headed and dizzy.	①	②	③	④
2.	There are times when I have very little energy and then just afterwards I have about the same energy level as most people.	①	②	③	④
3.	One minute I can be feeling OK and then the next minute I'm tense, jittery, and nervous.	①	②	③	④
4.	I frequently switch from being able to control my temper very well to not being able to control it very well at all.	①	②	③	④
5.	Many times I feel nervous and tense and then I suddenly feel very sad and down.	①	②	③	④
6.	Sometimes I go from feeling extremely anxious about something to feeling very down about it.	①	②	③	④
7.	I shift back and forth from feeling perfectly calm to feeling uptight and nervous.	①	②	③	④
8.	There are times when I feel perfectly calm one minute and then the next minute the least little thing makes me furious.	①	②	③	④
9.	Frequently, I will be feeling OK but then I suddenly get so mad that I could hit something.	①	②	③	④
10.	Sometimes I can think clearly and concentrate well one minute and then the next minute I have a great deal of difficulty concentrating and thinking clearly.	①	②	③	④
11.	There are times when I am so mad that I can barely stop yelling and other times shortly afterwards when I wouldn't think of yelling at all.	①	②	③	④
12.	I switch back and forth between being extremely energetic and having so little energy that it's a huge effort just to get where I am going.	①	②	③	④
13.	There are times when I feel absolutely wonderful about myself but soon afterwards I often feel that I am just about the same as everyone else.	①	②	③	④
14.	There are times when I'm so mad that my heart starts pounding and/or I start shaking and then shortly afterwards I feel quite relaxed.	①	②	③	④
15.	I shift back and forth between being very unproductive and being just as productive as everyone else.	①	②	③	④
16.	Sometimes I feel extremely energetic one minute and then the next minute I might have so little energy that I can barely do a thing.	①	②	③	④
17.	There are times when I have more energy than usual and more than most people and then soon afterwards I have about the same energy level as everyone else.	①	②	③	④
18.	At times I feel that I'm doing everything at a very slow pace but then soon afterwards I feel that I'm no more slowed down than anyone else.	①	②	③	④

How often do you attend church, synagogue, mosque, or other religious meetings?

☐Never ☐Once a year or less ☐A few times a year ☐A few times a month ☐Oncea week ☐A

My religious beliefs are what lie behind my approach to life?

☐ Not at all like me ☐ Not really like me ☐ Somewhat like me ☐ Very much like me

Following are four general relationship styles that people often report. Place a checkmark next to the letter corresponding to the style that best describes you or is closest to the way you are. Next after each statement rate how well or poorly each description corresponds to your general relationship style:

1 Strongly disagree; 2 Disagree; 3 Slightly disagree; 4 Neither agree or disagree; 5 Slightly agree; 6 Agree; 7 Strongly agree

____ A. It is easy for me to become emotionally close to others. I am comfortable depending on them and having them depend on me. I don't worry about being alone or having others not accept me.
1 2 3 4 5 6 7

____ B. I am uncomfortable getting close to others. I want emotionally close relationships, but I find it difficult to trust others completely, or to depend on them. I worry that I will be hurt if I allow myself to become too close to others.
1 2 3 4 5 6 7

____ C. I want to be completely emotionally intimate with others, but I often find that others are reluctant to get as close as I would like. I am uncomfortable being without close relationships, but I sometimes worry that others don't value me as much as I value them.
1 2 3 4 5 6 7

____ D. I am comfortable without close emotional relationships. It is very important to me to feel independent and self-sufficient, and I prefer not to depend on others or have others depend on me.
1 2 3 4 5 6 7

Please answer according to your experience over the last week:

1. I have recurring thoughts about harm coming to my baby, my family, or myself.
   0 This is true most of the time
   1 This is true some of the time
   2 This is true only occasionally
   3 No, this is not true

2. I have recurring thoughts about my baby getting sick or having some kind of problem.
   0 This is true most of the time
   1 This is true some of the time
   2 This is true only occasionally
   3 No, this is not true

3. I check on my baby multiple times throughout the night.
   0 This is true most of the time
   1 This is true some of the time
   2 This is true only occasionally
   3 No, this is not true

4. I have thoughts about my baby that scare me.
   0 No, this is not true
   1 This is true only occasionally
   2 This is true some of the time
   3 This is true most of the time

Is there anything else you would like to tell us? ☐No ☐Yes:

_____

_____

Please read this consent form carefully, and feel free to ask questions you might have.

Purpose and Procedure: The Maternal Mental Health Program is an ongoing program of research (Ethics # Beh 07-10). From time to time we do studies on moods and the pregnancy and postpartum experience. We would like to invite you to participate in research by allowing us to use the information you have provided in future studies. Your participation is voluntary. If you decide to take part in this study, you are free to withdraw your consent at any time without having to give any reasons. You may refuse to answer questions you are not comfortable with.

Potential Risks: There are no known risks to participating. Not participating will not affect your access to care.

Potential Benefits: Although there may be no direct benefits these studies to you, such studies help to improve services and treatment for women like you. These studies may be presented to researchers or published to help further the knowledge of mood and anxiety problems.

Storage of Data: The information collected will remain in your confidential clinical file while you are active with the program. Research data that is collected will not bear your name and will be identified only by number and accessed only by the researchers. Research data will be stored separately on a password protected computer in a locked office for a minimum of 5 years within the Department of Psychiatry, College of Medicine, University of Saskatchewan.

Confidentiality: You will not be identified by name in research data or any reports to come out of the research. No individual information will be reported. Any data will be reported in an aggregate way. Information will remain as confidential as the law allows.

Right to Withdraw: You have the right to refuse to participate in research or not to have your information used for research at any time and this will in no way affect the clinical services that you receive. If you wish to withdraw, data will be deleted at your request.

Questions: If you have any questions please contact Dr. Angela Bowen at the College of Nursing, 306-966-8949 or Dr. Marilyn Baetz in the Department of Psychiatry 306-844-1310. Any questions regarding your rights as a participant may be addressed through the Ethics Office (306-966-2084). Out of town participants may call collect.

Consent to Participate:

Would you be willing to allow the information you have provided to be used for the purpose of research? Yes No

I have read and understood the description provided above; I have been provided with an opportunity to ask questions and my questions have been answered satisfactorily. I consent to participate as described above and understand that I may withdraw this consent at any time. A copy of this consent form has been given to me for my records.

_____ **(Name of Participant)** _____ **(Date)**

_____ **(Signature of Participant)** _____ **(Signature of Researcher or designate)**

Email address: _____

1. Would you be willing to be contacted in the future for us to follow your progress? Yes No

2. Would you be willing to give the name and phone number of a relative or good friend who would be a contact and who will always know where you are if you move?

_____	_____	_____
Name	**Phone Number**	**Email address**

The University of Saskatchewan and Saskatoon Health Region: Improving health through excellence in education, research, and clinical care.